SEPTEMBER • 1954

Process Handbook

PETROLEUM REFINER

REFINING | PETROCHEMICALS | NATURAL GASOLINE

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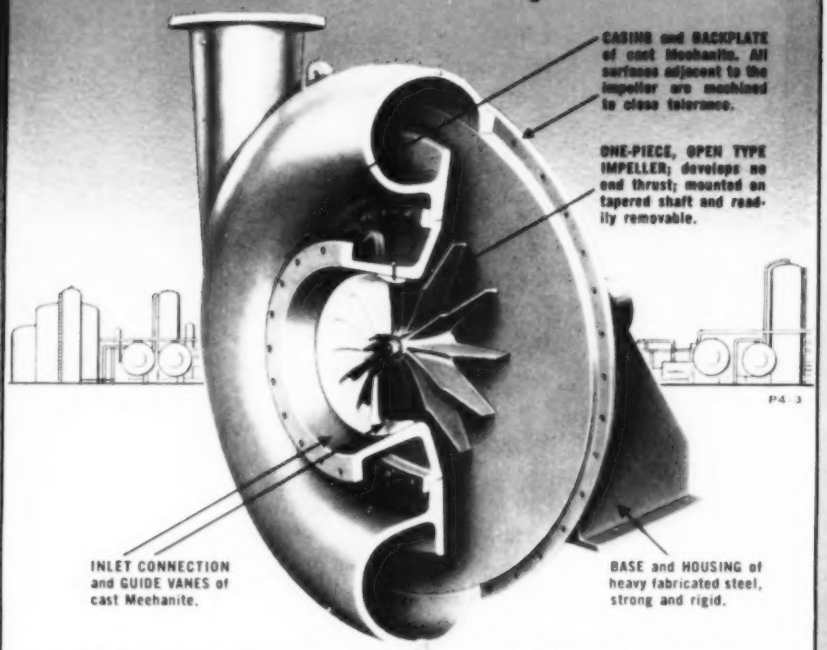
CASING and BACKPLATE of cast Meehanite. All surfaces adjacent to the impeller are machined to close tolerance.
ONE-PIECE, OPEN TYPE IMPELLER; develops no end thrust; mounted on tapered shaft and readily removable.
INLET CONNECTION and GUIDE VANES of cast Meehanite.
BASE and HOUSING of heavy fabricated steel, strong and rigid.

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They're extremely simple in design and construction. Hundreds are serving in processes requiring the handling and compression of large quantities of air or gas. Elliott compressors are made in both single-stage and multi-stage types, for pressures up to 1000 psig, with capacities to 175,000 cfm. The Elliott Company also builds the motor or turbine drive, including speed-increasing gears when required. For details and specifications, consult your local Elliott field engineer, or write to the Elliott Company, Centrifugal Compressor Dept., Jeannette, Pa. ELLIOTT Company

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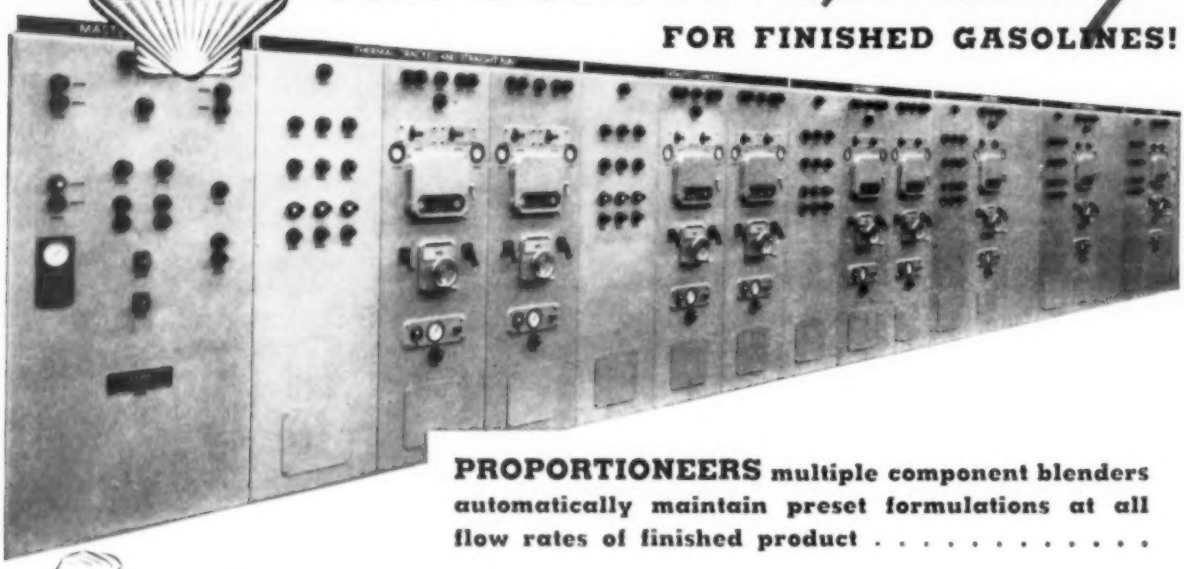

PROPORTIONEERS multiple component blenders automatically maintain preset formulations at all flow rates of finished product . . . . . .

SEE "STREAM BLENDING" AT WORK

A new Shell-Proportioneers film graphically illustrates the Wood River blending installation together with calibration and product separation techniques employed. We will gladly loan this film for educational use.

Shell Products Pipe Line's Wood River Pump Station automatically blends six gasoline base stocks, T.E.L., dye, and gasoline additives directly to the pipe line without using intermediate tankage.

Proportioneers Blender is made up of standard panels for operation from either mechanical or differential metering equipment. All control panels are synchronized and electrically interlocked so that the failure of any component stream will either isolate the blend manifold or rack up shortages on memory totalizers for later correction. Any number and type of components can be handled at finished product rates from 150 barrels per hour to the limit of modern transfer pumping equipment and pipe line sizes.

Proportioneers equipment is used in stream blending other finished products such as solvents, Diesel fuels, lubricating oils, heating oils, bunker fuels, and asphalt cutbacks.

For Proportioneers Bulletin SM-2060 or special bulletin for specific applications listed above, write Proportioneers, Inc., 112 Harris Avenue, Providence 1, Rhode Island.

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Volume 33, No. 9 September, 1954

PETROLEUM
REFINER
REFINING | PETROCHEMICALS | NATURAL GASOLINE

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A Quick Look at This Issue

PROCESS HANDBOOK

Process Handbook . . . The REFINER staff has prepared a most complete, neatly packaged tour through refining processes available in the industry. In this section you will find 69 flow descriptions and 69 flow diagrams for the most important licensed processes. Each is described in terms of its application, charge, products, operating conditions, yields and commercial installations. The processes are broken down according to the following groups: catalytic cracking and reforming, thermal conversion, gas conversion, light hydrocarbon recovery, oil distillation processes, solvent refining, and treating. The foreword to this unique handbook begins on **page 111.**

Gasoline Blending Stocks . . . This 16-page article covers the refiners' biggest problem—how to meet gasoline quality demand. Charts provide comparative susceptibilities and sensitivities of the usual refinery gasoline blending stocks—straight run, thermally cracked or reformed, catalytically reformed, catalytically cracked and catalytic polymer. To aid in interpreting these charts, another series of charts was drawn for the hydrocarbon classes. Yet a third series enables the refiner to refer to some standard octane number the different qualities of gasoline obtained from any given cracking stock by different cracking severities. The method is based on the yield octane relationships for both thermal and catalytic reforming. See **page 284.**

When to Replace a Pump . . . Check the hidden costs of operating an old pump. Power, depreciation and repair costs may run higher than the cost of a modern replacement. Here's an article and chart that show you how to do it. **Page 300.**

Cooling Fluids with Finned Coils . . . If you've got fin fan units in your plant, these correlations will tell you what kind of heat transfer you can expect. The authors have also made tests on pressure drops on such units and have come up with a generalized correlation. **Page 303.**

Locating Optimum Feed Tray . . . Tray-to-tray calculations are time-consuming and in many cases require extensive equilibrium data. Here is a fast and accurate short-cut method. Not only is the method explained thoroughly, but a comparison of its ac-

Turn Page

A Quick Look at This Issue

curacy is made against tray-to-tray calculations, beginning on **page 307.**

The Eastern States Story . . . Here is an intimate picture of the plan of operation of a 50,000-barrel-per-day independent plant which manufactures the gamut of petroleum products for customers having their own outlets. "We'll shift our operations for a 100,000-barrel tanker order," said an official. Here's how they do this—at a profit. See **Page 310.**

Understanding the Chemistry of Petrochemical Reactions, Part 16 . . . This part of the series is concerned with the production and the reactions of butadiene. This highly reactive petrochemical finds its major use in synthetic rubber. It is combined with styrene or with acrylonitrile to form rubbers with very different characteristics. It is one of the largest volume petrochemicals now being produced. Because of its reactive nature, it offers many possibilities for uses other than for rubber. For an interesting study of its production and possible uses, see **page 311.**

What Is the Octane Picture? . . . The first installment in this two-part series depicted the trends and forecasts in the gasoline octane muddle. The concluding section presents hitherto unpublished information on the effect on road octanes of certain controllable gasoline quality factors. In addition, you well may profit from serious study of the outline proposed for utilizing laboratory and road testing programs to insure optimum use of gasoline octanes. **Page 315.**

What Does a College Recruiter Look for in a Job Candidate? . . . Here, from the "dean" of college recruiters, are some tips on enlisting the best brains from college campuses and, no less valuable, an analysis of the value and purpose of the recruiting programs. **Page 106.**

Rumors Can Ruin You! . . . Riots have been started, banks closed and companies crippled because somebody whispered a vicious word. There's the Bogey rumor, the Pipe Dream rumor and the Hate rumor, equally dangerous to your company. Learn to forestall them. Turn to **page 107.**

Engineering: The Profession with a Glittering Horizon . . . The nation's bill for searching out scientific knowledge during 1952 was about $3.75 billion, or more than 1 percent of our gross national product. Research, of course, is vital to progress and the national well-being. But are there enough engineers available to carry on a long-range research program? For a provocative discussion of an important subject, turn to **page 376.**

Where's the Fire? . . . Continuing his discussion of fire extinguishment in oil processing, storage and transport facilities, H. B. Williams of Pan American Refining Corporation details the procedure for combating fires in agitators, tank cars and barges. Here is more meaty material which every fire protection director should keep handy. **Page 380.**

The New Tax Law—Challenge to Business . . . For the first time in 75 years the U. S. has a brand-new tax law. It is of concern to every taxpayer. It is a challenge to every business—a challenge to exercise a new economic freedom. Here are some tips on how to utilize it to your best possible advantage. **Page 390.**

Bacteria: Oil's Rediscovered Frontier . . . In the world of bacteria, man has uncovered a few of the whys and wherefores of his own existence. Moreover, the findings are of more than academic interest. In a new book, *Petroleum Microbiology*, Dr. Ernest Beerstecher, Jr., concludes that the study of ways and means of harnessing the unusual catalytic properties of bacteria for the good of the petroleum industry and of stemming their destructive activities is about to come into its own as a new and separate field. **Page 400.**

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• 55 process descriptions • 55 flow diagrams • 7 summation articles

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Industrial Marketing Magazine presented PETROLEUM REFINER with an award of merit for the Petrochemical Process Handbook. This award was earned for outstanding single issue published during 1953.

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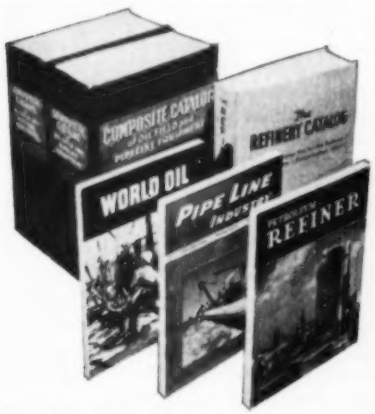

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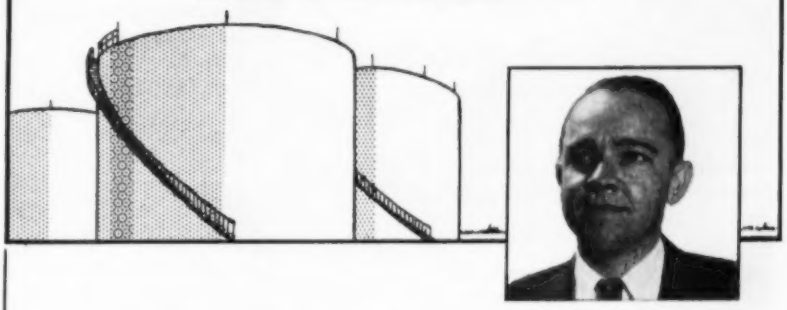

Putting Grand-Dad to Bed. With a final burst of effort, the biggest Process Handbook of all times has been put to bed. This grand-daddy of all special issues has durn near been the ruination of our process editor, George Gibbs, who has labored hard and long to produce it. His tribulations started back in September, 1952, when the entire staff was invited (and accepted happily) to criticize the '52 Handbook, then just off the presses. These slings and arrows outraging George's fortunes were used to great advantage in improving the present volume.

Industry guests at our annual Editorial Conference are always somewhat astonished at our painstaking attention to even the smallest of details. But we realize that it is important to make the magazine *look* good as well as *read* good, even though this impression may be only in the readers' subconscious mind. For example, we spent the better part of a day haggling over the shade of blue ink to be used in the flow diagrams, called in our own art experts, disagreed with them and threw them out, reconsidered and hauled them back and went along with their verdict.

In February, we convened a panel of refining experts in the Beaumont-Lake Charles area, submitted our tentative plans for this edition, asked them to tear it apart, and they did. Then George kissed his wife goodbye, and lit out across country calling on contributors all over the nation, with some help from our district editors. He cursed and cajoled the licensors into furnishing the right kind of information on the processes, made them standardize their flow diagrams, and where they wouldn't, we redrew them ourselves.

Well, anyway, it's done. Win, lose, or draw, it will have to serve as the single most authoritative source of process information available anywhere in the world. At least until the next one comes out in September, 1956—we should live so long!

★ ★ ★

We Ain't Proud so we didn't mind *Coronet Magazine* borrowing one of our best authors—Auren Uris—for a piece in their August issue entitled "Build Your Own Job Security." Mr. Uris has written several excellent articles for our As Management Sees It section, including the widely reprinted "You're Fired!" The only hitch about this borrowing is that Coronet might flat ruin him with manuscript checks fatter than those coming out of Houston.

★ ★ ★

How Do You Say It? We note with interest that the American Chemical Society's nomenclature committee will conduct an open forum at the fall meeting of the ACS to decide whether "*petrochemical*" is the right word to describe chemicals from petroleum. We would say off-hand that the nomenclature committee must not have a heap to do. The word has been popularized to the point of acceptance in the vernacular by publications such as REFINER, is a part of the name of many companies, and it's just mighty doubtful that the ACS could engineer a change. And why should they?

—*Bob Phillips*

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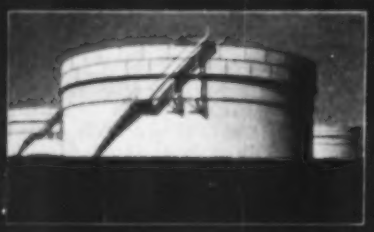

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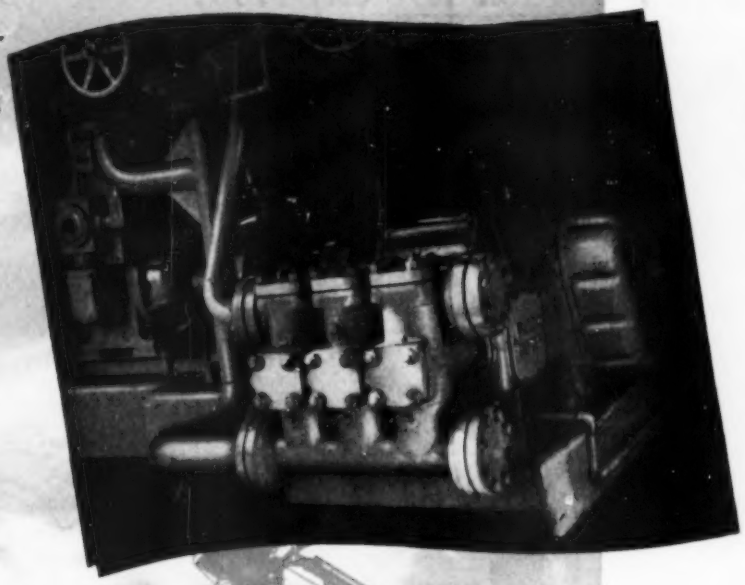
"This Wilson-Snyder Triplex Pump



is performing so well in Reactor Charge Service for our Platforming Unit at Grandfield, Oklahoma,

that we're using

TWO MORE

—in our Ben Franklin Refinery at Ardmore!"

— says Dr. I. Arthur Anson
Vice President in Charge of Refining
Bell Oil and Gas Company

Bell Refinery, Grandfield, Oklahoma

—in Bell's Grandfield Refinery

. . . a Wilson-Snyder Triplex plunger pump, size 3¾" x 6", is the reactor charge pump for the U.O.P. designed platforming unit which went on stream in June, 1951.

This pump is equipped with hardened steel plungers (500 Brinell) and heat-treated and hardened drop-forged stainless steel valve service. It utilizes the output of a 50-hp. electric motor, through a gear reducer, to develop differential pressures of 800 to 900 p.s.i. through 4" intake and 3" discharge piping; handling hydrocarbons having a specific gravity of 0.67 at pumping temperatures of 275°F.

—in the Ben Franklin Refinery at Ardmore

. . . two more Wilson-Snyder pumps of the same size and type will be used in the new "cat" unit. One of these pumps will serve as the fresh feed pump—the other as a recycle and quench pump.

When You have pumping applications that demand reliable performance, contact "Oilwell's" nearest Refinery Specialist at Area office points shown below and get complete information on . . . WILSON-SNYDER REFINERY PUMPS.

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Ask the experts! The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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Suggested as a substitute for 0.50% Mo. steel. Has greater creep strength and somewhat better corrosion and oxidation resistance than 0.50% Mo. steel. For use in cracking furnace tubes, high pressure boiler tubing, superheater tubing and high temperature steam piping.

23 TIMKEN STEELS FOR HIGH TEMPERATURE SERVICE

Carbon	Sicromo 2		
Carbon-Mo.	Sicromo 2½	Sicromo 5S	16-13-3
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Silmo	Sicromo 3	Sicromo 7	25-12
DM	4-6% Cr.-Mo.	Sicromo 9M	25-15*
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		18-8 Cb	

*Not available as seamless tubing at the present time.

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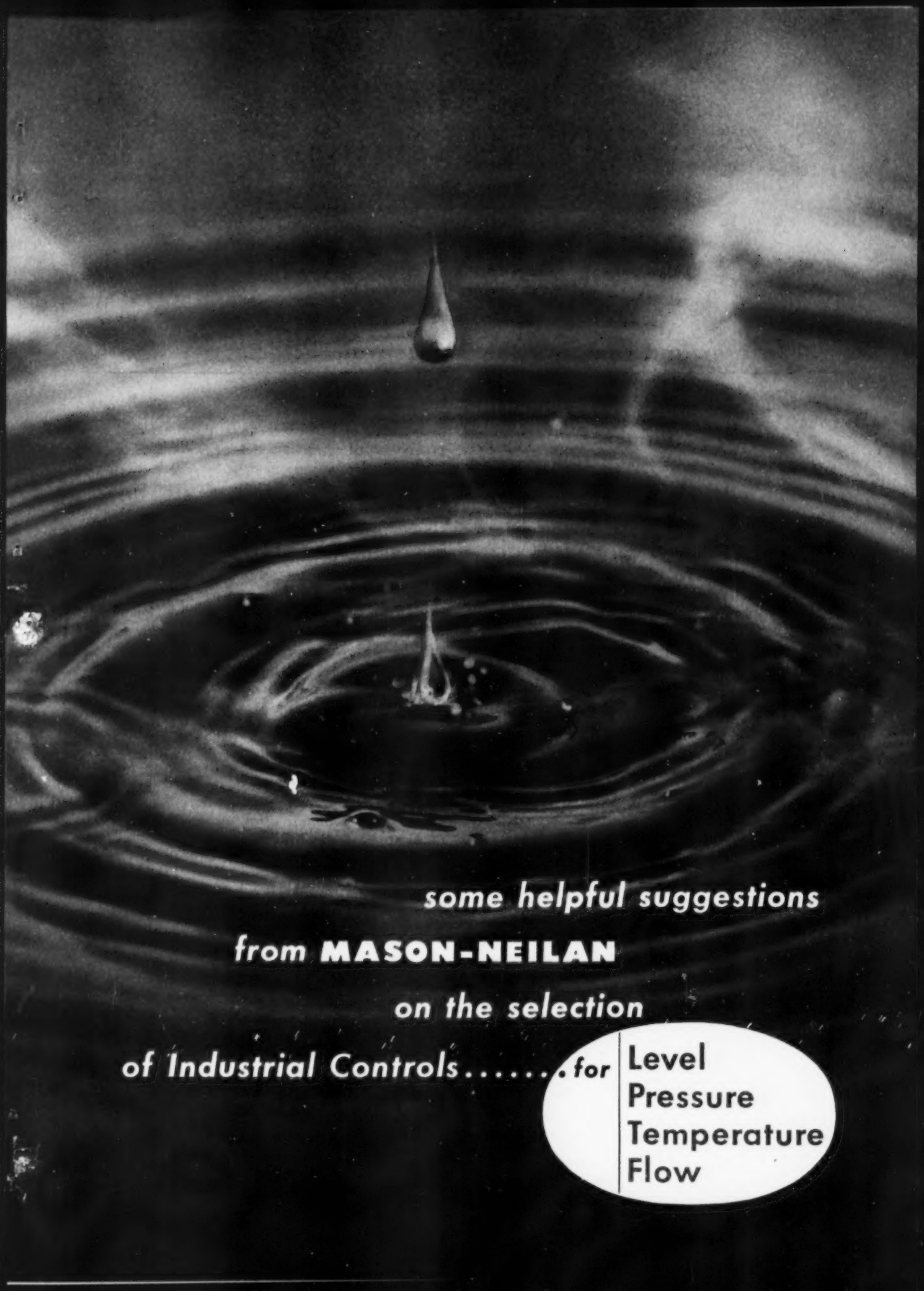
some helpful suggestions
from MASON-NEILAN
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of Industrial Controls.....for
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Pressure
Temperature
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in selecting a Control Valve

consider and compare these Practical Factors

Accurate Performance

Look for these qualities, which insure accuracy — plugs designed, manufactured and tested to provide *desired flow characteristics* over widest practical range. Combination of smallest practical minimum flow with large diameter seat rings and long stroke, for *wide usable flow range*. Responsive, *powerful motor* with moulded diaphragm and premium quality, especially designed springs. *Accurate alignment* through precision machining, piloted key parts, rigid over-all construction. *Minimum friction* due to accurate alignment, type and finish of guides, finish of stems and packing box parts.

Stamina

Consider probable service life — will it give accurate performance over a long period under the required conditions? Essential to stamina is over-all strength and strength of individual parts. *Over-all strength* requires a rigid yoke, rigidly connected to the valve bonnet. This assures a structure which will not deform in rough handling to cause misalignment and faulty operation. *Strength of individual parts* results in resistance to wear and corrosion — check such important details as *stem sizes and jointing* to insure continuous service under high torsional stress; *heavy plug and guide sections;* tightness and *prevention of distortion* in seat rings; *bolted packing box* for maximum safety; selection and/or treatment of materials to *resist erosion and corrosion.*

Economy

Maintenance can be an important item — servicing and down-time run into important money. Consider factors which minimize maintenance time and speed up return to service — for example, *through-bolted diaphragm case* which avoids water pockets around bolts, permits use of flat stock diaphragms in emergency; *location of stroke indicator and positioner take-off* on *motor* stem; *wide yoke opening; drive nut clamp attaching motor* to bonnet; *removal of motor without disturbing packing box; interchangeable, precisely uniform parts; external spring adjustment; automatic establishment of initial diaphragm position; full information* on serial plate.

Masoneilan Control Valves give you more for your money because they are built up to the job — not down to a price. In most cases they are comparably priced but in the long run they *cost you less* because real cost is price *plus* maintenance and down-time costs. In selecting control valves consider *all* the quality factors.

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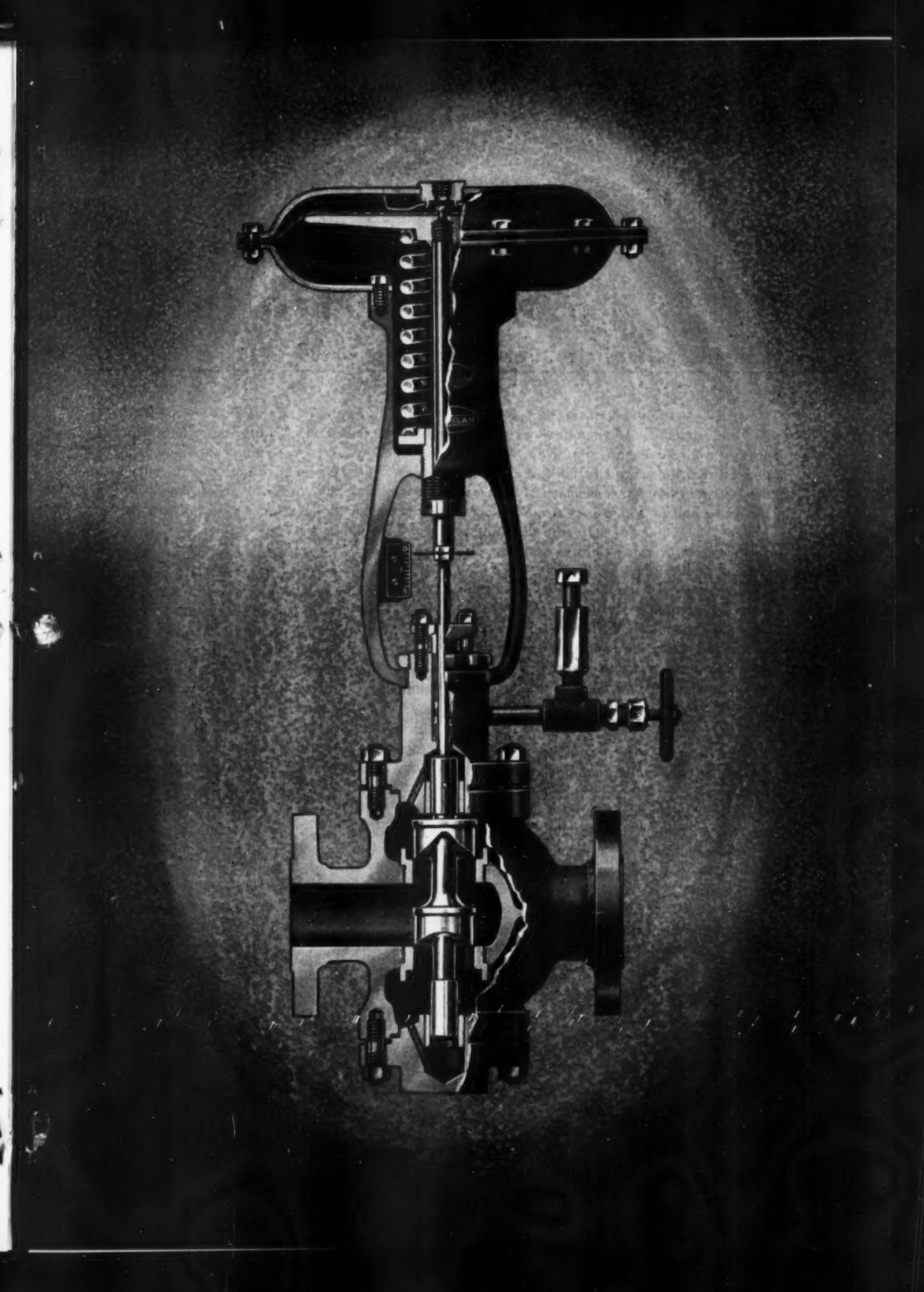

in selecting a Level Controller

consider simplicity, versatility, economy

Simplicity is important in that inherent "trouble spots" and lost motion are eliminated, operation and sensitivity are improved and servicing is facilitated. Look for these quality factors. A *minimum of tubing* in the instrument provides easy access to components, simplifies air circuits; *unit subassembly construction* facilitates settings, adjustments, servicing and field conversion. *Compactness and simplified mounting dimensions* provide ease of handling and installation. *Separation of specific gravity and proportional band adjustments* avoids complications. *Ease of reversing control action* and *simple, visible settings* are aids to operators. *Minimizing and simplifying alignment* procedure facilitates start-up.

Versatility provides for service in a *broad range of applications* from simple on-off limit controls to integration in complex continuous processes. *Variations* possible *in basic instrument*, with or without simple changes in components, *reduces investment* in equipment. For example, use of controller for proportional, proportional-reset, differential-gap control, or pneumatic transmission. Also availability of the supplemental function of pneumatic set, plus combinations of controller types in a single case. Availability of wide selection of materials is important in meeting service condition requirements. A wide choice of level ranges and mounting connections and the ease of instrument orientation simplifies selection and piping design problems.

Economy is achieved through wide choice of ranges, materials and mountings, providing ease of selection and installation. Of equal or greater importance are design features which minimize maintenance and speed up servicing. Unit construction of subassemblies, simplified air passages, level indication, simple alignment and setting procedures are factors in maintenance and service operations, as are ease of access to controller instrument and its components. Long service life through use of most suitable materials and sturdy construction reduces over-all cost.

Like other Masoneilan Controls, 12000 Series Level Controllers are designed and built to give you more for your money. Although comparably priced, they cost less in the long run because long life and low maintenance and down-time costs reduce their *real* cost to a practical minimum.

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MASONEILAN

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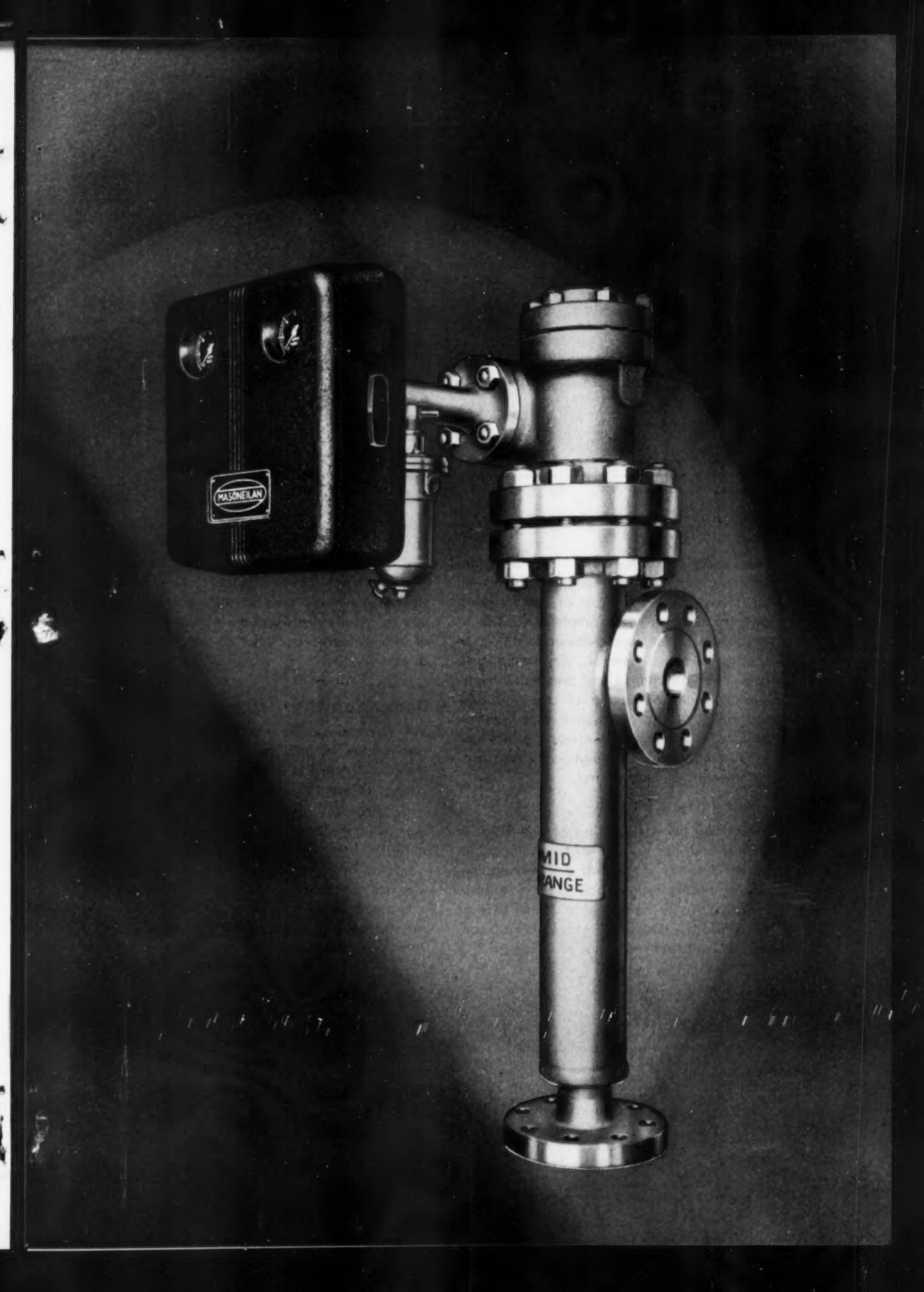
MASONEILAN
MID
ANGE

in selecting a Pneumatic Controller

check these important considerations

Versatility

The *variety of control types* available in the basic instrument may reduce initial investment and subsequent cost of instrumenting process changes. For example, the basic instrument may be used without modification for proportional control, differential-gap control, on-off control and pneumatic transmission; with substitution of one unit subassembly, for proportional-reset control; and, with addition of the appropriate unit subassembly, for pneumatic-set, time-program or differential control.

Simplicity

Minimizing linkage and use of *simplified air circuits* and *unit subassemblies* eliminates inherent trouble spots and lost motion, improves sensitivity and operation, facilitates servicing, adjustment and start-up. *Ease of adjustment, setting* and *reversibility* of control action assists operator in tuning in.

Economy

Low initial investment and minimum changeover costs are basic economies. Additional savings are made possible through *minimum service* requirements and the *ease and speed* of *maintenance*, because of simplicity of design.

Dependability

Where complications are "designed out" dependability is built in. An excellent performance record in a wide variety of applications attests the soundness of the design.

Among controllers of its type, the Masoneilan 60000 Series Controller is outstanding because it offers greater value — greater simplicity, versatility and economy and unsurpassed performance. Investigate its advantages — ask for complete information — and a demonstration in your own plant.

Complete data on request — **write**

The Choice Where Quality of Product Depends on Quality of Equipment.

MASON-NEILAN REGULATOR CO.

1182 Adams St., Boston 24, Mass., U.S.A.

MASONEILAN

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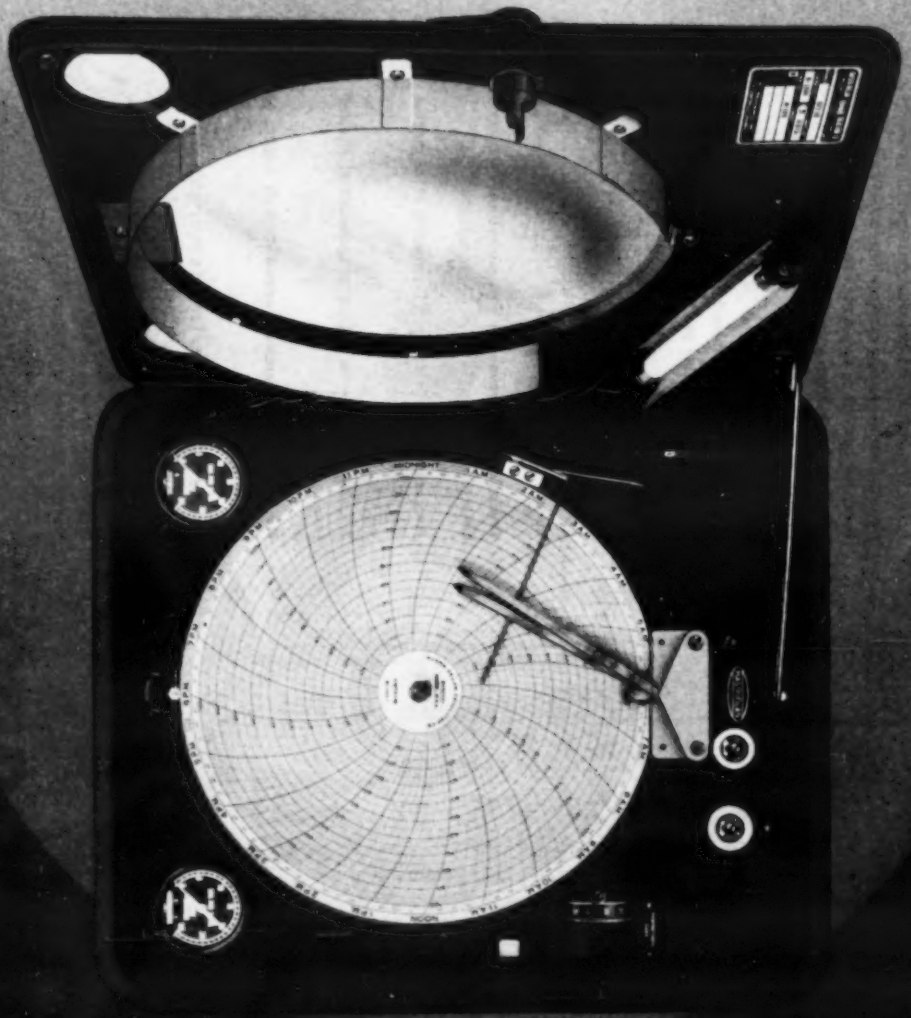
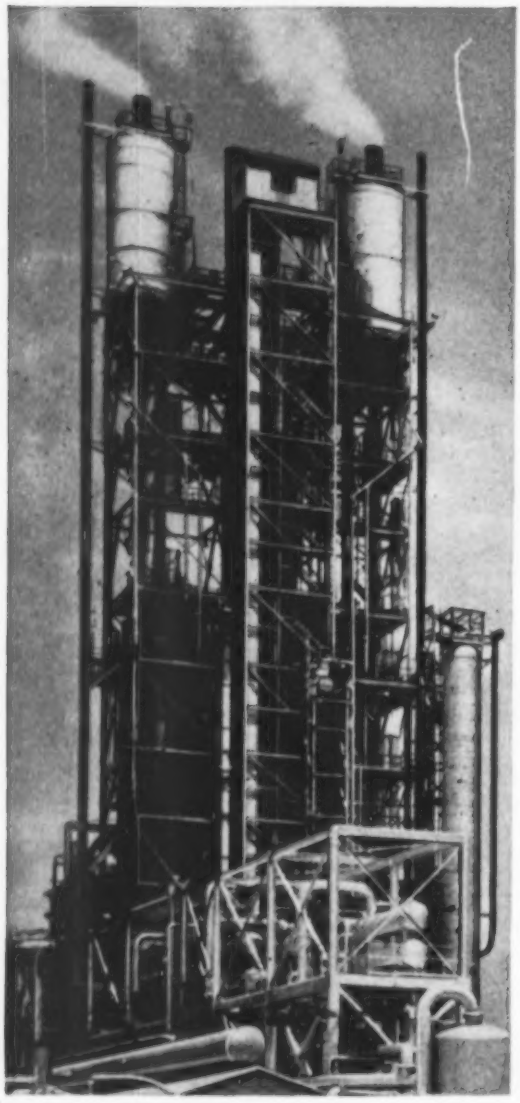


when you install catalytic cracking equipment—

investigate the economy

of **TENAMENE**

inhibitor-sweetening



Nearly all catalytically cracked gasolines respond to Tenamene inhibitor-sweetening—The economy inherent in this single sweetening-gum inhibiting process should be considered by all refiners now constructing or contemplating the construction of cat-cracking units. Important factors which may influence your plans are:

Double function—Tenamene 2 acts both as antioxidant to inhibit gum formation, and as a sweetening agent.

Low cost—only 5 lbs. of Tenamene 2 per 1000 barrels of gasoline usually are needed . . . about ½¢ per barrel.

Low installation cost—the process to sweeten with Tenamene is so simple, very little basic equipment is needed.

Savings on maintenance and operation—these costs are negligible compared to most other processes.

No octane loss—no danger of the presence of free sulphur —as in some processes.

No gasoline loss—no addition of chemicals at elevated temperatures.

No deleterious chemicals added—such as sulphur or copper.

PROMPT SERVICE: Eastman's highly qualified technical staff and modern gasoline laboratories are at your service. We welcome the opportunity to discuss Tenamene inhibitor-sweetening with you at your convenience. Contact your local representative or write to Eastman Chemical Products, Inc., Kingsport, Tennessee—a subsidiary of Eastman Kodak Company.

Tenamene

EASTMAN GASOLINE ADDITIVES

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tenn.; New York — 260 Madison Ave.; Framingham, Mass. — 65 Concord St.; Cincinnati — Carew Tower; Cleveland — Terminal Tower Bldg.; Chicago — 360 N. Michigan Ave.; St. Louis — Continental Bldg.; Houston — 412 Main St. **West Coast: Wilson Meyer Co.;** San Francisco — 333 Montgomery St.; Los Angeles — 4800 District Blvd.; Portland — 520 S. W. Sixth Ave.; Seattle — 821 Second Ave.

CLOSE THE LOOP...

from **MECHANIZATION** to **CONTROL**

PANELLIT has designed and built Automatic Control and Information Systems for the complete control of processes since 1943. Whether you are in a fabricating or a processing industry, Panellit alone offers:

- Basic System Design and Engineering
- *Impartial* selection of instruments and components
- Assembly and Fabrication of *complete* systems
- *Panalarm*—Integrated Alarms for Safety
- *Panascan*—Scanning, Data-Processing and Data-Reduction systems
- Installation, field check-out, inspection

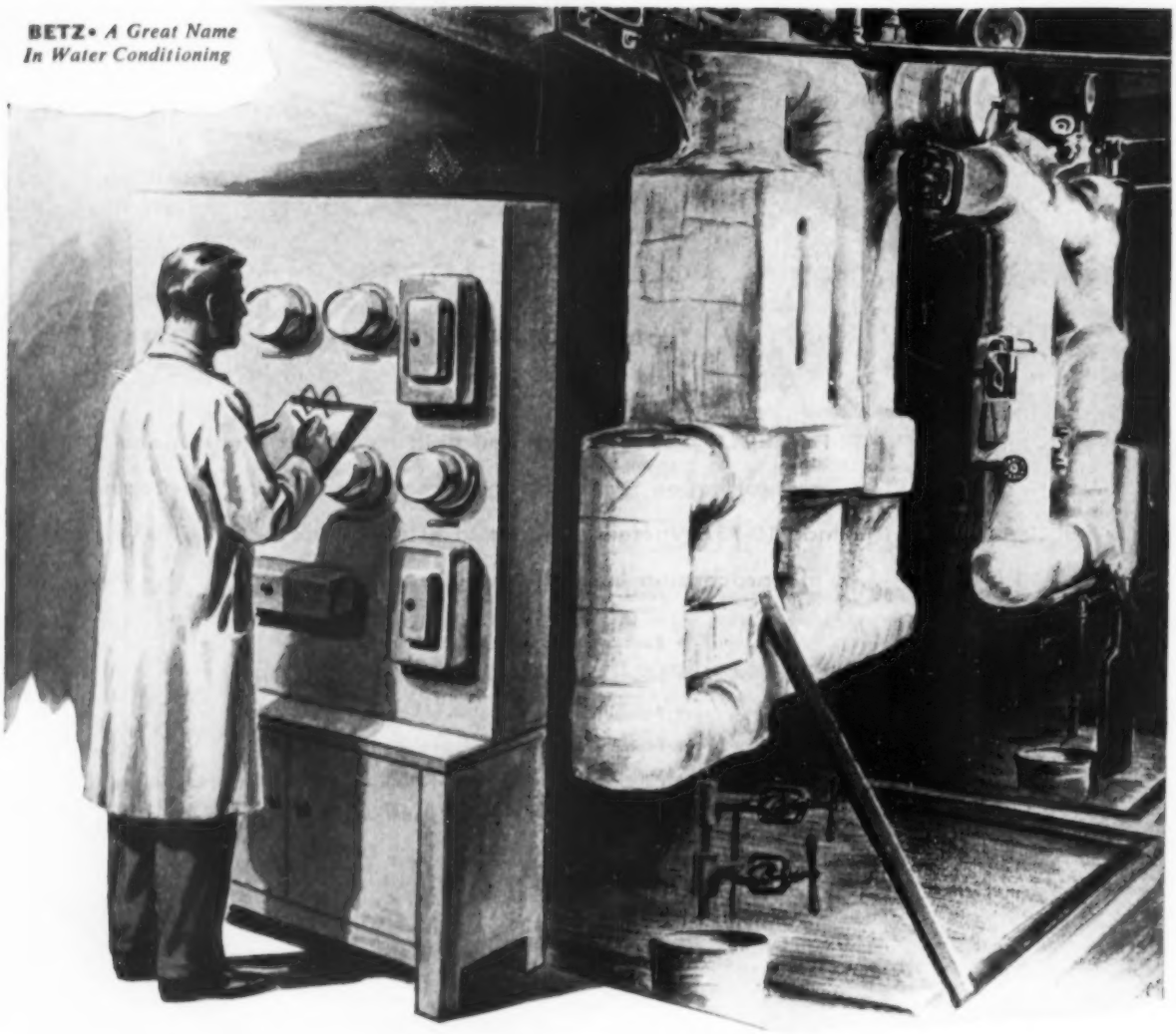
PANELLIT, Inc.
7415 North Hamlin Avenue
Skokie, Illinois

PANALARM
Alarm and Safety Division

PANASCAN
Scanning and Data-Reduction Division

For more data on advertised products, use Readers' Service Cards, last page.

BETZ• *A Great Name*
In Water Conditioning



Proving ground for an idea

Many of today's industry-accepted water conditioning techniques were unknown just a few short years ago. Yet they were made possible by the extensive research which is carried on daily at our headquarter laboratories in Philadelphia.

Little wonder then, that we consider our *continuing* program of research and development so important.

The testing and retesting of new chemical compounds and formulations—*under actual plant conditions* in complex "Tom Thumb" equipment like this—is only a small part of our research program conducted to assure better water conditioning for industry.

As a result, advanced Betz discoveries, tested in the laboratory and *job-proved* in the field, have vastly increased operating efficiency and economy in industrial plants, petroleum installations, and institutions—everywhere.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

For more data on advertised products, use Readers' Service Cards, last page.

PETROLEUM CHEMICALS DIVISION

NEWS

September ★ One of a Series of Interest to the Petroleum Industry ★ 1954

This new booklet helps dealers answer customer complaints on poor power

How do your dealers react when a customer complains that the gasoline they sell lacks power? Do they lose the customer? Or are they able to counter with some ready and convincing sales ammunition?

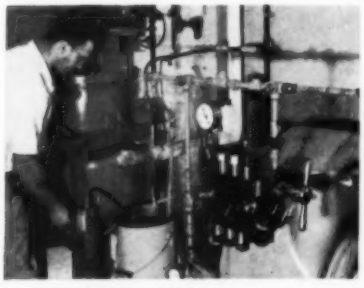
If they have trouble answering these complaints in a way that keeps the customer coming back, the four-page folder shown above can be a big help to them. It describes the many mechanical troubles that can cause power loss . . . such as poor spark plug condition, improper distributor or carburetor settings, leaky intake manifold and the various factors contributing to low compression. And it discusses them in a simple, easy-to-understand style.

Ask any Du Pont Petroleum Chemicals Division representative for a sample copy, and for information on obtaining them in quantities for your dealers.

New Silica Grease Thickener Announced

Here is a *new type* of grease thickener!

This new additive, Estersil GT, is quite different from any thickener previously used in commercial grease production. It is made by Du Pont and sold exclusively by the Du Pont Petroleum Chemicals Division.



IN THIS PILOT PLANT at the Du Pont Petroleum Laboratory, we will be glad to help you formulate improved greases with Estersil GT and your own oil stocks.

Chemical "Raincoat"

The new material, an estersil, is a pelletized form of finely divided amorphous silica. One of its outstanding properties is a water repellent "raincoat" which is chemically attached to each tiny particle.

This chemically bonded "raincoat" means that you can now make a grease with unusual resistance to washout or breakdown in the presence of water.

Synthetically Made

Estersil GT is completely synthetic. And it was specially developed by Du Pont for grease compounding. With it, you can easily prepare a unique *multi-purpose* grease that will give remarkable endurance on even the most gruelling assignments.

In addition to water resistance, your greases made with Estersil GT will show unusually high thermal stability, superior oxidation stability, and exceptional shear stability under both normal and high temperature conditions. They possess superior handling qualities, too.

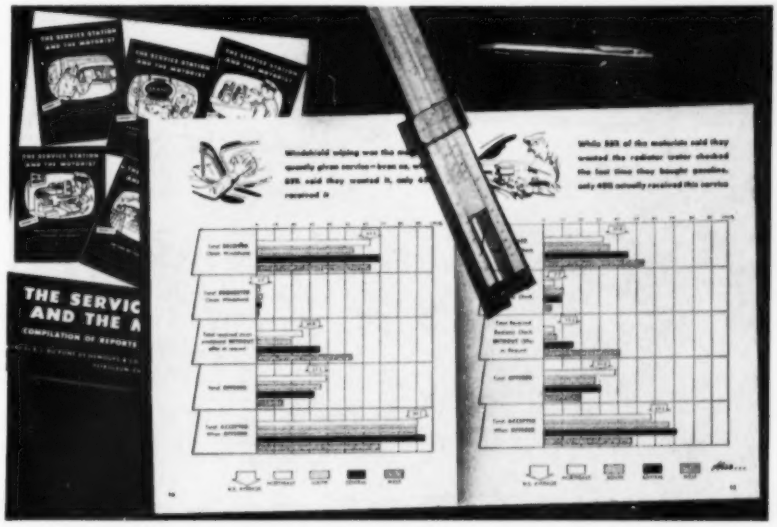
For more information and free samples of Estersil GT, address your request to our Wilmington office.

YOUR CUSTOMERS TOLD US!...

And we have now published their preferences in a single volume to help you evaluate services and promotions.

During the past year and a half we have published six different reports on the extensive Du Pont survey of service station customer buying habits and preferences. But the demand for these individual reports has far exceeded the supply.

Now, to help catch up with the demand and to provide marketing men with the over-all story in one handy reference book, we have combined all the reports into a single volume for selective distribution.



YOUR CUSTOMERS ARE AN "OPEN BOOK" when you keep handy a copy of this Du Pont survey report, "The Service Station and the Motorist."

The new book covers many different aspects of oil company marketing and customer purchasing habits. And it is arranged in chapters according to the following breakdown:

1. Selection of the service station and customer loyalty to the station.
2. Brand name recognition

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED

Survey Report

and loyalty to brand.
3. Knowledge of gasoline grades and reasons for purchase.
4. Price, credit cards and charge accounts.
5. Oil and TBA purchases.
6. Services wanted by the motorist, asked for by the motorist, and given by the dealer.

By providing you with an accurate reading of customer preferences, this new book can help you tailor promotions for maximum effectiveness and efficiency.

How It Was Done

The survey is the result of thousands of household interviews with service station customers . . . and many more thousands of actual observations at the pump island where purchases are made. The interviews show what customers *think* and *say* about your products and dealer services. The observations, taken at 1,193 different service stations, show what customers *actually do* when making a purchase. The survey itself, which was conducted by National Analysts, Inc., is completely impartial.

Regional and Seasonal Breakdowns

National in scope, the survey is so organized that the findings can be analyzed according to region—for the four main marketing areas of the country. Separate breakdowns by sex, income and age of the respondents are also included, as well as breakdowns for age and price of car.

What's more, the service station observations are catalogued according to seasons—and based on about 6,000 observations during each of the four seasons.

In addition to the one-volume report, the complete information collected by this survey is recorded on IBM cards. Thus, it can be cross-tabulated to provide a wide variety of specialized breakdowns.

As such, we believe this Du Pont survey of consumer gasoline and TBA buying habits to be the most comprehensive, penetrating and accurate ever undertaken by any segment of the petroleum industry.

Special Distribution

Although the new one-volume report on this survey is not available to marketers all the way down the line, it will be distributed on request to marketing executives. And it is ideal . . . as reference material . . . for use by oil companies in preparing condensed marketing information for general dealer distribution.

SEATTLE DISTRICT MANAGER

ROBERT E. HOLETON is the district manager in charge of sales for the Du Pont Petroleum Chemicals Division in Washington, Oregon, and Idaho. His headquarters are in Seattle.

He joined the Du Pont Company as a chemist in 1933. After a wide experience in a number of Du Pont laboratories and semi-works areas, Mr. Holeton was transferred to the Petroleum Chemicals Division in 1949.

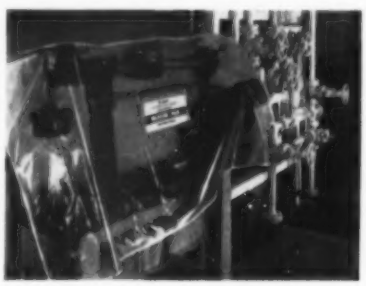
Prior to his present assignment in the newly created Seattle District, he was a sales-service representative in the Division's Eastern Region.

He is a graduate of Temple University and a member of the American Chemical Society.

ROBERT E. HOLETON

New Way to Protect Blending Plant Scales and Weightographs

A lightweight polyethylene cover is now available to you on request for protecting blending plant scales and weightographs during washdowns.



The new scale cover was specially designed for this purpose by Du Pont. It fits neatly and can be removed quickly.

A large card identifying the mix in the weigh tank appears on the facing side of the cover. Made in two sizes, the covers are designed to fit any blending plant scale installation.

The new scale covers have already been installed in many plants. Refiners using them report excellent results in helping prevent rust which may be caused by excessive moisture accumulation during blending plant washdowns. The scale covers also provide protection against corrosive action when equipment is not in use. And they have greatly improved housekeeping efficiency in blending plants where former makeshift covering required special handling.

For a cover to protect this equipment in your own blending plant, ask a Du Pont representative or send your request to the nearest Du Pont Petroleum Chemicals Division regional office.

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • *Wilmington 98, Delaware*

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NEW YORK, N. Y.—1270 Ave. of the Americas Phone COlumbus 5-3620
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A-7872

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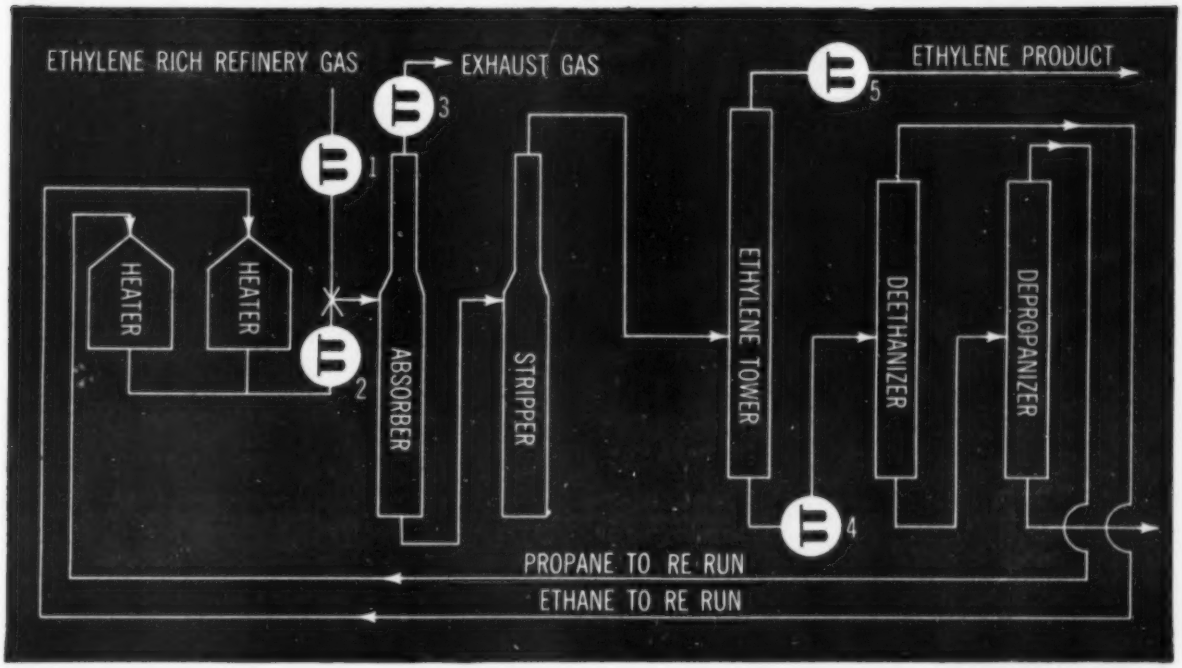
TRUE CONTROL BEGINS WITH ANALYSIS...



Ethylene purity guaranteed through use of Tri-non® Analyzers

Even though many elements of process stream environment – temperature, pressure, flow-rate – are under control, a chemical process may not be operating at peak efficiency and product quality suffers.

Why?

Because, environmental control gives no indication of basic stream changes like feed stock composition, loss in stripper efficiency, catalyst poisoning, etc., all of which may effect end product quality.

In chemical processing, it is essential that true control *begin* with analysis–either batch-wise in the control laboratory, or continuously on the process stream itself.

In the ethylene purification shown above, purity and maximum recovery is guaranteed by infrared analytical control at five points: 1–Ethylene analysis on feed stock for accounting purposes and process control; 2–Ethylene analysis beyond crackers; 3–Ethylene analysis of absorber off-gas for absorber efficiency; 4–Ethylene analysis in ethylene tower bottoms for fractionation tower efficiency; 5–End-point analysis for ethylene purity.

Let Perkin-Elmer engineers show you how your process can benefit through ANALYTICAL CONTROL–made possible with infrared plant stream analyzers.

Both the TRI-NON *and* BICHROMATOR Analyzer *continuously record the concentration of any desired stream component. Each is sensitized and adjusted to specific plant conditions before shipping.*

THE PERKIN-ELMER CORPORATION
813 Main Avenue, Norwalk, Conn.

Gentlemen:

☐ Send information on the application of infrared analytical control to the following process problem: .....

.....

☐ Send literature on your infrared plant stream analyzers

☐ Have a sales engineer call

Name ..... Title .....

Company .....

Address .....

PERKIN ELMER — *FIRST IN ANALYTICAL CONTROL*

For more data on advertised products, use Readers' Service Cards, last page.

For GREATER SAFETY...

It's the Shand & Jurs ruggedly constructed Internal Safety Valve for petroleum storage and transfer tanks. Designated by S&J as Fig. ST-6810, this all-steel safety valve must be opened manually, and can be held open by a chain and fusible link which will melt at 165° F. Should an exposure fire endanger the tank and its contents, the fusible link will melt, allowing the internal valve to close instantly by internal spring pressure.

The S&J Internal Safety Valve is constructed in one unit, and can be mounted on standard A.P.I. nozzles. The valve may be closed manually in case of a broken line or other necessity. The entire valve has been carefully designed to provide full flow, ease of operation and maintenance, and to assure maximum safety in the handling of inflamable petroleum products. For additional details of the S&J Internal Safety Valve, Fig. ST-6810, write the nearest branch listed below or the factory.

S&J

Shand and Jurs Co.
BERKELEY 10, CALIFORNIA

NEW YORK
342 Madison Ave.

CHICAGO
10409 S. Western Ave.

HOUSTON
M & M Bldg.

TULSA
Thompson Bldg.

LOS ANGELES
714 W. Olympic Blvd.

REPRESENTATIVES:
SEATTLE: Nebar Supply Company, 3000 Western Avenue
MONTREAL: Lytle Engineering Specialties, Ltd., 360 Notre Dame St., W.
TORONTO: Lytle Engineering Specialties, Ltd., 85 Richmond St., W.
VANCOUVER: P. D. McLaren & Son, Ltd., 3277 Main Street
CARACAS: Sinclair Spence, C.A., Edificio Galipan
ENGLAND: Whessoe, Ltd., Sales: 25 Victoria St., London, S.W. 1.
Whessoe, Ltd., Works: Darlington, County Durham

Just name the valve needed--

POWELL can supply it!

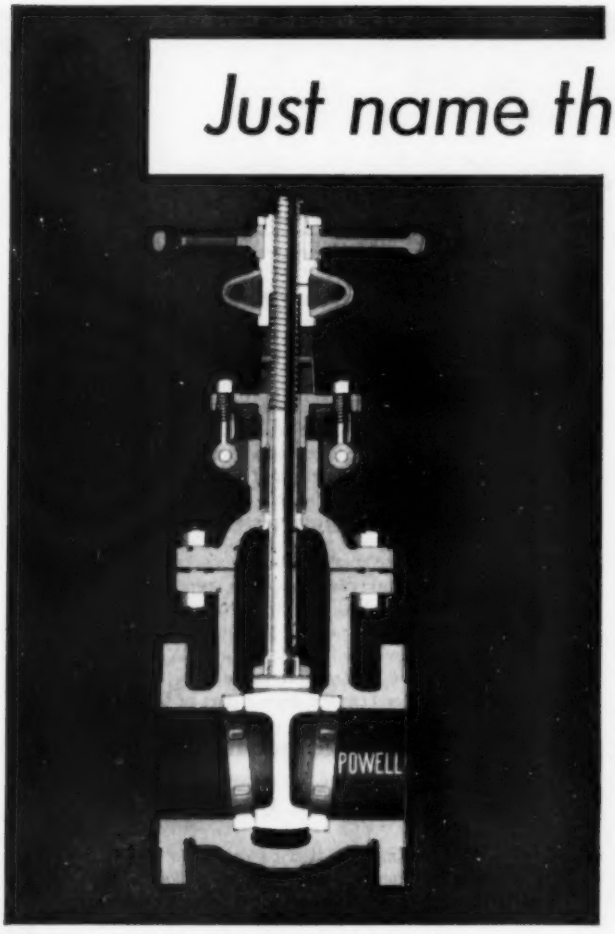


FIG. 1503 (*sectional*) **—150-POUND CAST STEEL GATE VALVE.** Flanged ends, bolted flanged bonnet with outside screw rising stem and yoke. Solid wedge. Available in sizes 1" to 24", inclusive.

You'll find just the valve you need in the complete line of Powell Valves. For Powell probably makes more kinds of valves—and has solved more valve problems—than any other organization in the world.

And Powell Valves have a record of dependable flow control since 1846.

Powell Valves are made ⅛" to 30" and 125 pounds to 2500 pounds W.S.P. Bronze, iron, steel and corrosion resistant alloys. Available through distributors in principal cities. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

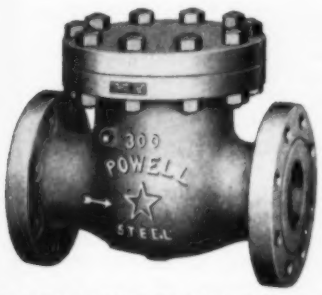


FIG. 3061—300-POUND CAST STEEL SWING CHECK VALVE. Bolted flanged cap. Heavy rugged construction. Available in sizes 1" to 12", inclusive.

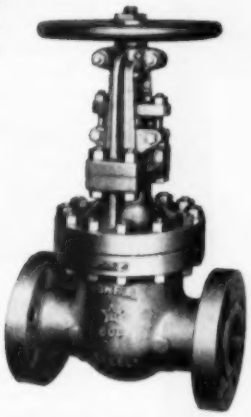


FIG. 6003—600-POUND STEEL GATE VALVE. Flanged ends, outside screw, rising stem. Available in sizes 1" to 24", inclusive.

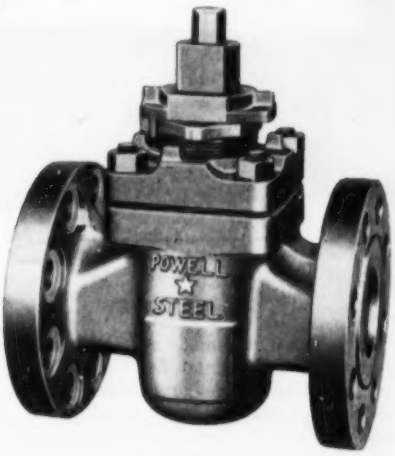


FIG. 1559—150-POUND STEEL FLANGED END LUBRICATED PLUG VALVE. (300-pound Steel, Fig. 3059.) Available with Screwed or Bolted Glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel valves available for 150 and 300 pounds W.P.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves 108th year

For more data on advertised products, use Readers' Service Cards, last page.

Field Test Shows: New gel-type ALCOA Activated Alumina improves dehydration of high-pressure natural gas

Results of the first 35 months of a full-scale field test on ALCOA's new H-151 Activated® Alumina gel indicate that the new desiccant has greater and more lasting adsorption power, has greater physical strength and is more resistant to particle breakdown in use.

After 20 months of operation, H-151 gel is capable of adsorbing 12.5 per cent water (to bring the gas to not over 7 lbs. water per M.M.s.c.f.), as compared to the figure of 7.5 per cent water on which most design calculations and specifications are based. Decrease in crushing strength over a 6-month period was only 18 per cent.

FIELD TEST

The field test was made at the Reddell separator station of Continental Oil Co., located 4 miles northwest of Reddell, La. This separator station receives natural gas (approximately 90 per cent methane by volume) from 17 wells in the area, with the average pressure at the well site being 2,400 psi. The normal flow from this field averaged 16 to 19 M.M.s.c.f. per day during the test period. Upon arrival at the separator station, the gas is expanded to approximately 850 psi. It then enters a number of separators where free water and distillate are removed.

The gas streams from the individual separators are combined and flow through a master separator where any additional liquid is removed. At this point the gas is free of any liquid, but is saturated with water and distillate vapors at the prevailing conditions of temperature and pressure. The gas stream then passes through the dehydration tower where the water is removed by the solid desiccant. The dried gas is metered and then recombined with the distillate for transmission to a gasoline plant.

DEHYDRATION TOWER

The dehydration tower used for the test is 16 ft. high and 3 ft. in diameter. Wet gas enters the tower at the bottom through a 4-in. pipe which extends above the top of the bed through the centerline of the tower. The gas is deflected downward through the bed by a bonnet at the top of this pipe. The dried gas leaves at the bottom of the tower.

REACTIVATION

Reactivation of the spent desiccant is accomplished by passing natural gas heated to approximately 360°F through the bed, countercurrent to the flow of the drying cycle. In normal operation, the towers at Reddell are switched every 8 hours. A tower is reactivated for 6 hours and cooled for 2 hours before being placed on the drying part of the cycle.

TEST PROCEDURE

The tower was charged with 3,900 lbs. of the new gel H-151 ALCOA Activated Alumina balls, ¼-in. to 6 mesh.

The first testing was carried out after the bed had completed several normal drying cycles. The tower was allowed to continue on stream without interruption until the water content of the effluent gas had gone above 7 lbs. per M.M.s.c.f. This quantity of water vapor is usually the standard allowable in the gas-transmission industry.

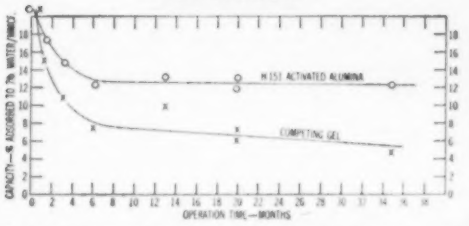
During a run, the water vapor contents of the inlet and the outlet gas from the dehydrator were determined at periodic intervals by standard methods. Gas flows were calculated from the readings on the orifice meter chart by a standard method.

Capacity test runs were made on the tower at seven different times. In addition to the data taken shortly after charging the towers, test runs were made after approximately 1, 3, 6, 13, 20 and 35 months of operation.

On two different occasions, once after 1 month's operation and again after 6 months' operation, the tower was opened and samples of the desiccant material removed from the top of the bed for screen analysis and determination of crushing strength.

For more data on advertised products, use Readers' Service Cards, last page.

TEST RESULTS



Performance record of Alcoa Activated Alumina H-151 and competing gel for 35-month period.

The typical run consisted of a fairly long period of constant effluent dew points which for all runs was below —20°F; a "break point" when the adsorption "front" reached the exit end of the bed; and then a period of constant rise in dew point. After 6 months of operation, the capacity of H-151 was 12.7 per cent, a much higher value than usually obtained with gel desiccant. After 20 months of operation, the capacity of the H-151 was still high, 12.5 per cent. After 35 months of operation, the calculated gas flow for H-151 was 10.39 M.M.s.c.f. over an 18-hour period. *Capacity was calculated to be 12.1 per cent* (7 pounds M.M.s.c.f. water content).

For the competing gel, however, the total gas flow was 4.66 M.M.s.c.f. over an 8.25 hour period. *Capacity was found to be 4.85 per cent.*

This higher-than-usual capacity for H-151 will enable existing units to run for longer cycles, with a corresponding decrease in reactivation cost, or at higher capacity, which will allow additional wells to be brought in. It will also allow the design of smaller-sized drying towers for new units on a particular job. Any of these, of course, represent real savings.

CRUSHING STRENGTH

The crushing strengths of the samples removed from the towers are also listed in Table 2. The test for this property consists of subjecting a weighted sample of 4-8 mesh material to a pressure of 1,000 psi. for 1 minute, and then measuring the amount of plus 8-mesh material remaining. The ratio of the weight of this fraction to the original weight is called crushing strength, and is expressed in per cent.

The new desiccant had an original crushing strength of 55 per cent, dropped to 45 per cent in 1 month and was still the same after 6 months. The per cent decrease in crushing strength was therefore approximately 18 per cent, much lower than ordinarily found in a gel desiccant.

TABLE 1—SORPTIVE CAPACITY DATA, NEW GEL

Date of test	Months of operation	Per cents Adsorbed* H-151
April 1951	0.1	18.8
May 1951	1.2	17.6
July 1951	3.3	14.9
October 1951	6.2	12.7
May 1952	13.0	12.8
December 1952	20.0	12.5
March 1954	35.2	12.1

*Per cent adsorbed to bring the gas to not over 7 lb. water per M.M.s.c.f.

TABLE 2—PARTICLE BREAKDOWN AND CRUSHING STRENGTH OF SAMPLES REMOVED FROM TOWERS

Mesh size	As Charged per cent	After 1 month's Service per cent	After 6 months' Service per cent
+4 mesh	82.0	84.9	70.8
4-8 mesh	17.9	14.3	24.8
8-14 mesh	0.03	0.76	4.3
14-20 mesh	0.01	0.02	0.1
20-28 mesh	0.01	0.01	0.01
28-42 mesh	0.01	0.01	0.0
-42 mesh	0.01	0.03	0.04
Total	99.97	100.03	100.05
Crushing strength, per cent	55.1	45.0	45.2

BED INSPECTION

The tower was blown down and opened for sample removal at the end of 1 month and again at 6 months. A visual examination of the material in the top of the bed showed that the balls had suffered little or no breakage. This fact is borne out in the screen analyses of these samples, along with that of the material as charged, which appear in Table 2.

PARTICLE BREAKDOWN

At the end of 6 months' operation, over 95 per cent of the gel was still larger than 8 mesh. This lack of particle breakage is important because pressure drop through the bed is kept at about 10 psi.

For further information and samples of this remarkable new ALCOA Activated Alumina, write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 717-J Alcoa Building, Pittsburgh 19, Pa.

ALCOA CHEMICALS

ALUMINUM COMPANY OF AMERICA

For more data on advertised products, use Readers' Service Cards, last page.

"DUNKED"
for your protection

Until a few years ago, if anyone had even *suggested* the use of a centrifugal compressor for over 1000 psi, the idea would have been considered absurd.

Today, pressures of not only 1000 psi, but in excess of *3000 psi*, can be safely handled by the new Clark "Barrel Type" Multi-Stage Centrifugal Compressor.

To assure complete safety to the operators, the cases of these units are hydrostatically tested by Clark at 1½ times maximum working pressure. As a final test, to detect any possible leakage when handling such hazardous gases as hydrogen, the units are pressurized with hydrogen in excess of maximum working pressure while submerged in water . . . *"Dunked" for your protection.*

Already refinery-proved, Clark "Barrel Type" Centrifugals are scheduled to be installed, in the near future, in 7 new catalytic reforming plants which will have a combined capacity of 100,000 barrels per day. They are equally well suited to many other high pressure applications, such as repressuring, ammonia synthesis and wind tunnels.

Your nearest Clark representative will give you complete details.

CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

CLARK compressors

Clark continues to set the pace in compressor progress

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K&M

"CENTURY" APAC

ASBESTOS-CEMENT SHEETS

Last Long, Look Good, Cost Little

No matter what your building plans, the chances are you can profitably use "Century" APAC sheets.

Being made from asbestos fiber and portland cement, APAC is fully resistant to fire and weather, rats and termites. Thus it serves equally well indoors or out—for walls, ceilings, liners, and partitions. Although its smooth, attractive surface takes decorative colors well, it doesn't require paint for protection—ever!

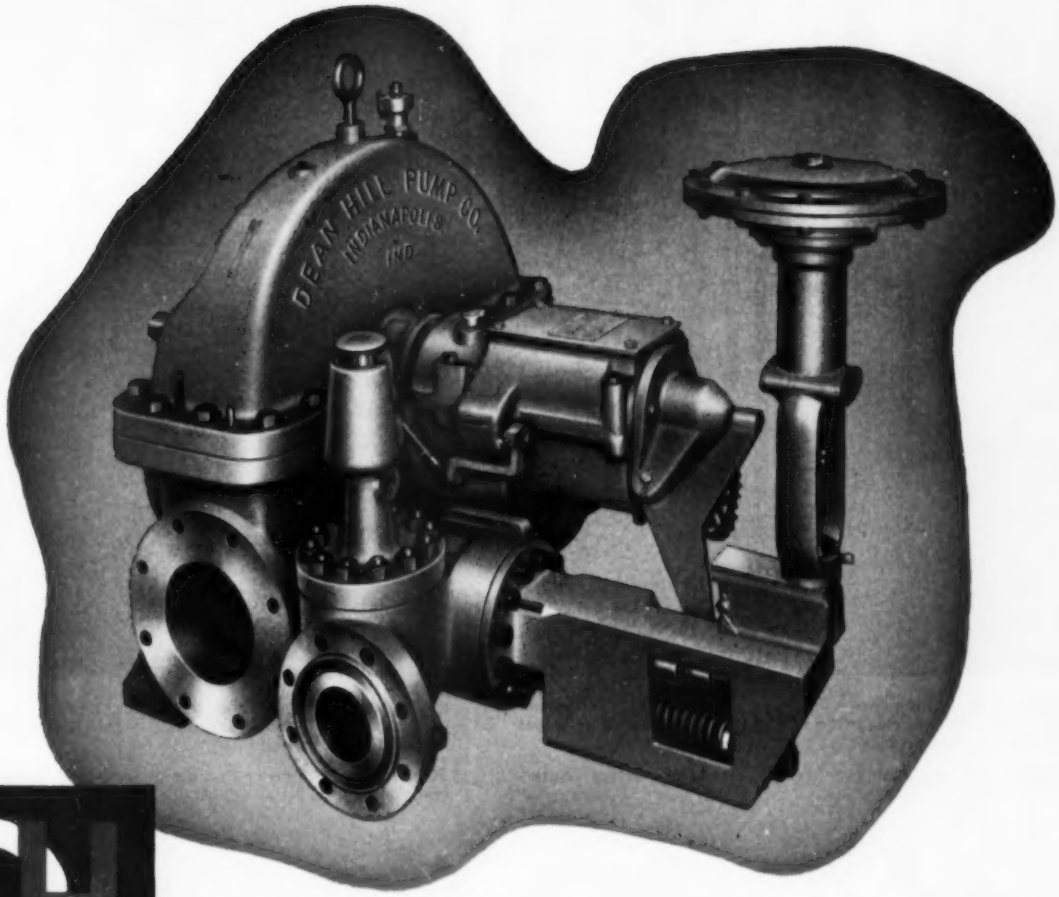
When it comes to cost, "Century" APAC is even more outstanding! It's made in 4′ x 8′ sheets that are easy to handle, easy to cut and drill, easy to apply with ordinary tools. This ease and speed of application does more than save you labor costs, too! APAC helps get new facilities into production faster; helps you to modernize existing structures without prolonged disruption of the work routine.

Your K&M distributor will gladly give you further details on versatile "Century" APAC sheets. Contact him soon, or write to us direct.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

K&M best in asbestos ®



D-H turbines with pressure regulators solve constant fluid pressure problems

Dean Hill Turbines equipped with pressure regulators are "made to order" for boiler feedwater applications requiring precise, automatic pressure control. Regulators can be used with any turbine model of either horizontal or vertical design and are furnished with direct-acting or remote control. They can be arranged to maintain a constant pump discharge pressure or a constant differential pressure over the boiler pressure.

The regulator controls all turbine speeds up to normal rating, but above this point the turbine governor overrides the regulator to prevent overspeeding. The emergency trip valve remains independent.

To effect maximum efficiency of control and eliminate lost motion and deflection, the regulator is mounted on a rugged support made of welded six-inch channels.

For further information on D-H Turbines and optional accessories

write today for Catalog 500.

DEAN HILL PUMP COMPANY

Pump and Turbine Engineers Since 1893

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Sales Offices In:

Chicago, New York, San Francisco, Boston, Cincinnati, Denver, Albuquerque, El Paso, Salt Lake City, New Orleans, Philadelphia, Tulsa, Los Angeles, Pittsburgh, Houston, Dallas, St. Paul, Toledo, Cleveland, Grand Rapids, Birmingham, Ala., Louisville, Memphis, Richmond, Mexico City, Montreal, Reading, Pa., The Hague, Washington, Charlotte, Casper, Wyo., Knoxville.

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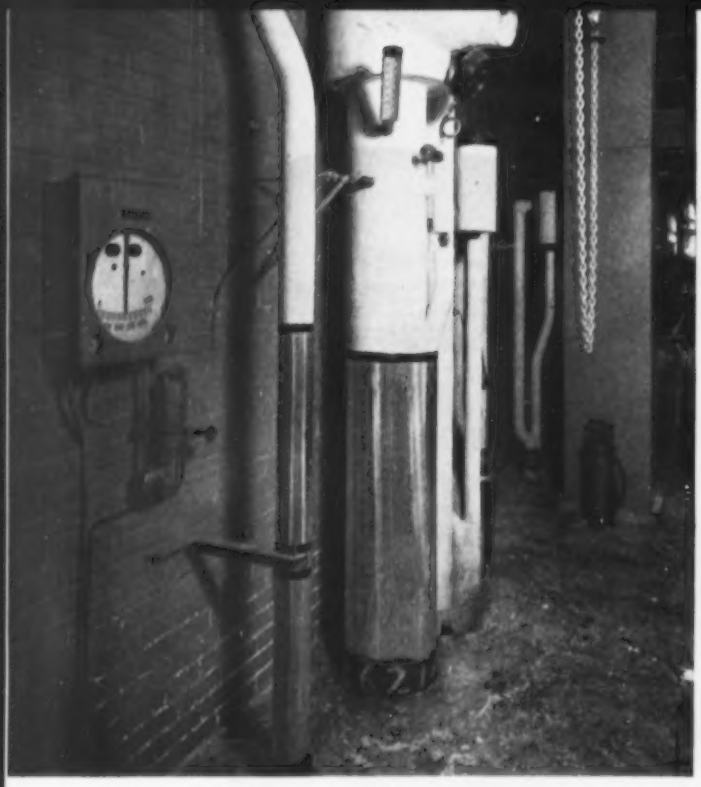


PROBLEM: High maintenance cost of canvas jacketing. High-pressure hot water hose used to clean floor damaged lower ends of lines and necessitated constant replacement.

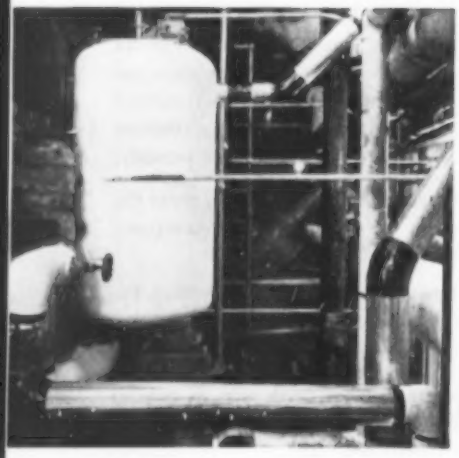
SOLUTION: Childers Aluminum Jacketing replaced canvas. Waterproof—easy to install—reusable.

PROBLEM: Extreme hazard of fire from static electricity generated in machinery. Canvas jacketing could burn easily causing danger to men and machinery in plant.

SOLUTION: Childers Aluminum Jacketing installed. Fireproof—easily cleaned of oil to reduce fire hazard.

Do Insulated Lines in Your Plant Cause These Three Common Problems and Hazards?

Read How Special Aluminum Jacketing Solved Them for Scott Paper Company



PROBLEM: Costly replacement of insulated lines damaged by oil drippage and bumping by men and tools.

SOLUTION: Maintenance engineers replaced canvas jacketing with Childers Aluminum Jacketing. Easy to wipe clean . . . durable and resistant to abrasion and abuse. Maintenance cost reduced.

The Scott Paper Company, Chester, Pa., and nearly 1,000 other modern plants in this country have protected insulated lines with Childers Aluminum Jacketing.

Childers Aluminum Jacketing cuts maintenance costs. It needs no upkeep . . . retains its protective value for years. Because Childers Aluminum Jacketing needs no painting, it can actually pay for itself in this saving alone. And of course, this modern aluminum jacketing can be removed and replaced easily for line repairs.

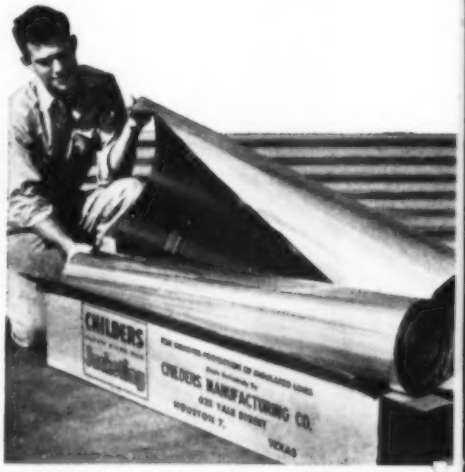
Easy installation cuts cost even farther. Only tools needed are pliers and wedge. Economical strapping holds jacketing securely—allows easy removal.

Try this low-cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation. For full details write to: Childers Manufacturing Company, Department PR-22, 3620 West 11th Street, Houston 8, Texas

SPECIFICATIONS

Childers Light-Weight Aluminum Jacketing

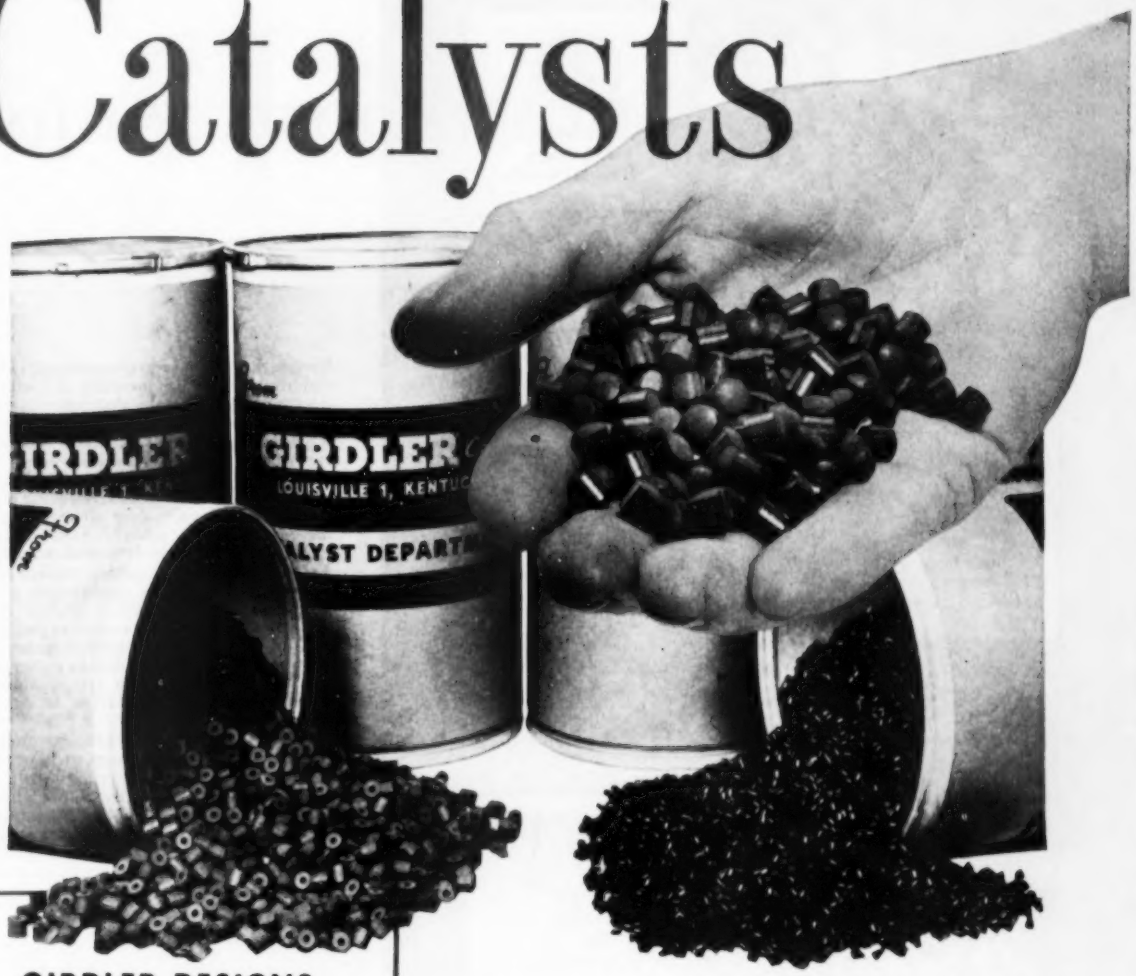
Shipped in rolls, 4 ft. wide; 100 ft. long with or without moisture barrier. Aluminum of .006" thickness. Cut with straight edge and dull knife. Write now for full details and engineering data.



LOW COST Childers Aluminum Jacketing answers many problems in plants all over the country. It's light weight, easy to install—goes on with simple bands. Weather, water, heat and fire resistant—can be used and re-used for years.

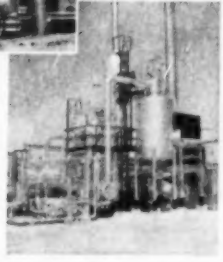
(Advertisement)

Catalysts



GIRDLER DESIGNS... ENGINEERS AND BUILDS PLANTS

...FOR purifying liquid or gaseous hydrocarbon mixtures



...FOR recovery of sulphur from hydrogen sulphide

How you benefit from GIRDLER leadership in catalyst technology

HIGH QUALITY Girdler catalysts enjoy industry-wide recognition as the answer to many tough catalyst problems. Girdler manufactures many types of catalysts for a wide range of processing applications. Our experienced catalyst technicians are well-qualified to work with you to prepare catalysts to meet your specifications. Or, if preferred, we will take your formulae and *tailor-make* catalysts to *your* exact requirements.

Why not take advantage of Girdler's experience in solving catalyst problems? For further information on standard, commercially-proven Girdler catalysts or on our catalyst engineering service, call the nearest Girdler office today.

The **GIRDLER** Company

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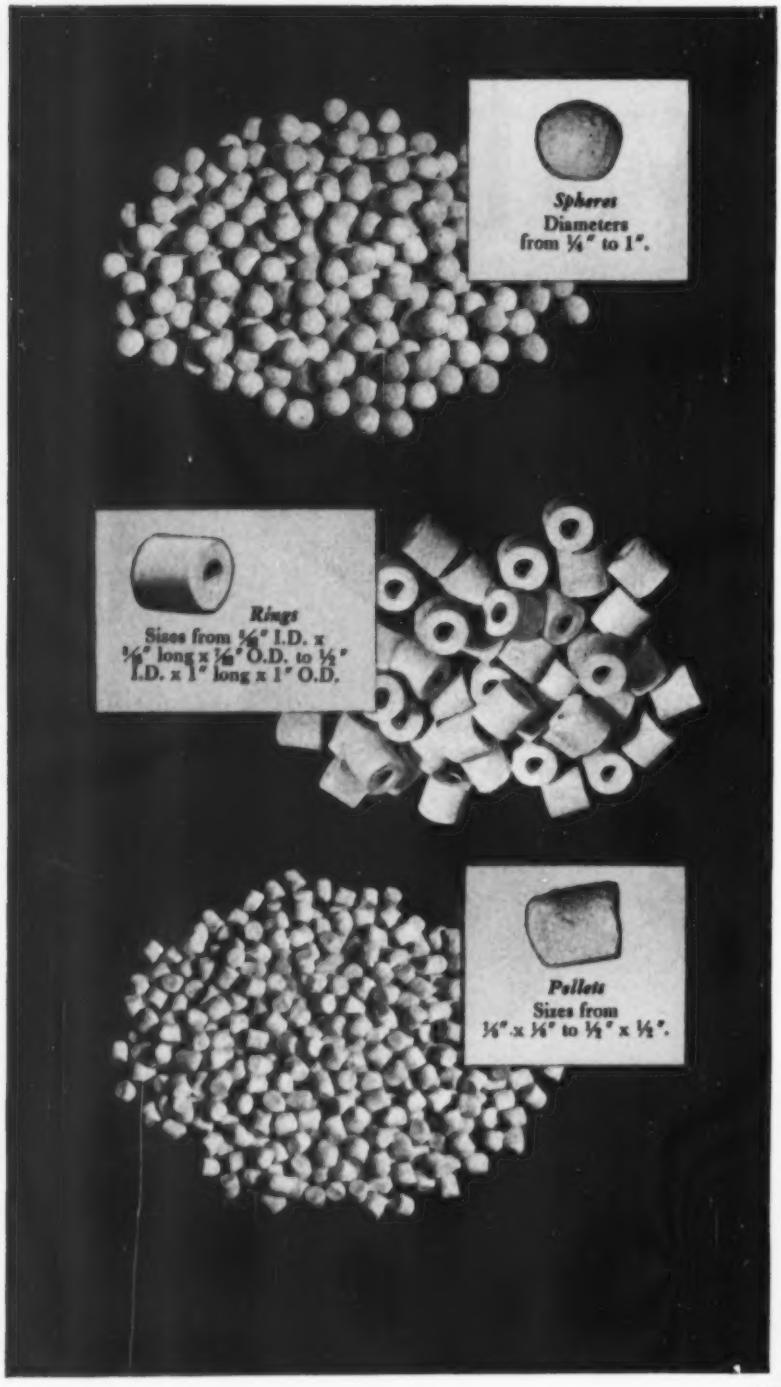
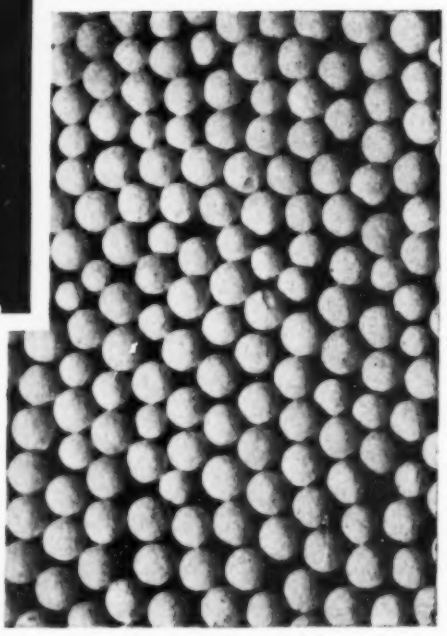


Rx for

Norton catalyst carriers — spheres, pellets and rings — are commercially available in ALUNDUM*, (fused alpha alumina) mixtures. Experimental quantities are available in MAGNORITE*, FUSED STABILIZED ZIRCONIA, CRYSTOLON* and MULLITE.

Norton spherical carriers provide uniform beds in catalytic converters, reducing channeling and pressure drop to a minimum. Medium porosity spheres have porosity ranging from 40% to 44% with a network of open pores on the outside surface only. These are suitable for applications where the carrier is coated with a catalyst. High porosity spheres have porosity ranging from 45% to 49%, with a network of open pores on the outside surface as well as throughout the entire sphere. These are suitable for applications where the carrier is impregnated with a catalyst.

Norton ALUNDUM carriers are proving highly successful in reaction such as those involved in the manufacture of phthalic anhydride, maleic anhydride and oxidation of ethylene. Containing 77% to 89% alumina, they are outstanding for chemical stability and resistance to abrasion and erosion. Write for Bulletin #7, containing additional data on ALUNDUM catalyst carriers.



Norton heat exchange pebbles are made of ALUNDUM.* Because of their high alumina content (over 95%) they are ideally suited for pebble type heaters, where they are important as the heat-transfer medium, whether oxidizing or reducing conditions are encountered.

Their ability to withstand abrasion, impact and repeated heating and cooling makes them ideal for heat exchange beds of either the static or moving type. Their high refractoriness prevents softening or incipient fusion at any point in the upper bed. This keeps them from "bridging" together and causing stoppages in a moving bed. ALUNDUM heat exchange pebbles are available in ¼, ⅝, ⅝ and ½" diameters.

For more data on advertised products, use Readers' Service Cards, last page.

higher production... better processing...lower costs

Norton refractories are engineered for top performance — and prescribed for many chemical applications

For your refractory uses, Norton refractory products are *engineered and prescribed* to give you the best possible ℞ — the most effective combination of physical characteristics plus thermal, chemical and electrical properties.

The ℞'s you need to improve and economize your processing are ready for you in this complete, top-quality line. For details, including expert technical aid, call in your Norton Refractories Engineer. Meanwhile, write for the fact-filled bulletins, mentioned in this advertisement, that cover your particular requirements for dependable, money-saving refractories. NORTON COMPANY, 468 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Canada.

NORTON

REFRACTORIES

Engineered... ℞ ...Prescribed

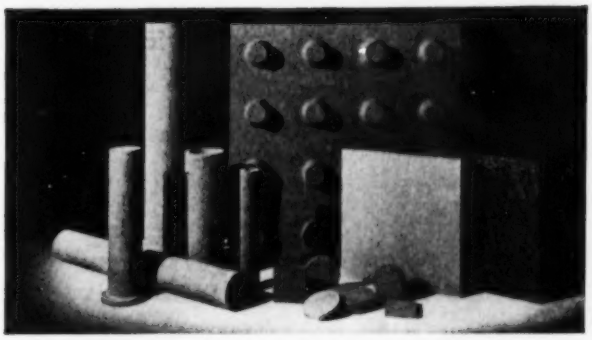
Making better products... to make other products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

Norton electric furnace shapes and laboratory ware

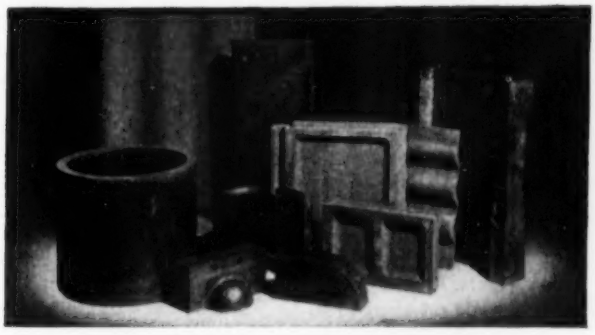
Norton electric furnace refractories — cores, tubes and muffles — are made of ALUNDUM or CRYSTOLON materials. ALUNDUM shapes, composed of 99% pure fused alumina, are characterized by great stability, chemical inertness, excellent thermal conductivity and good electrical insulation qualities. CRYSTOLON shapes, for use under more limited conditions, combine high thermal conductivity with resistance to heat shock. Bulletin No. 458 tells how to construct electrical furnaces for the laboratory.

Norton ALUNDUM laboratory ware, available at your laboratory supply house, offers many properties important to development, experimental or analytical work. It is chemically stable, stands temperatures up to 1900°C and is easy to clean. For filtering, it comes in four degrees of permeability. Bulletin No. 793 gives you the whole story.



Norton porous mediums come in plates, tubes, discs and diaphragms, engineered to fit your filtering, diffusing or aerating requirements. All have uniform porosity, in the size and open-pore ratio you need. Made of ALUNDUM material that is chemically stable and strong. Thus, their resistance both to acid and alkaline conditions gives them extra long life. Norton seamless porous tubes have the advantage, unusual in tubes, of uniform porosity over their entire area — permitting constant air or liquid pressure and enabling uniform backwashing to do more thorough cleaning.

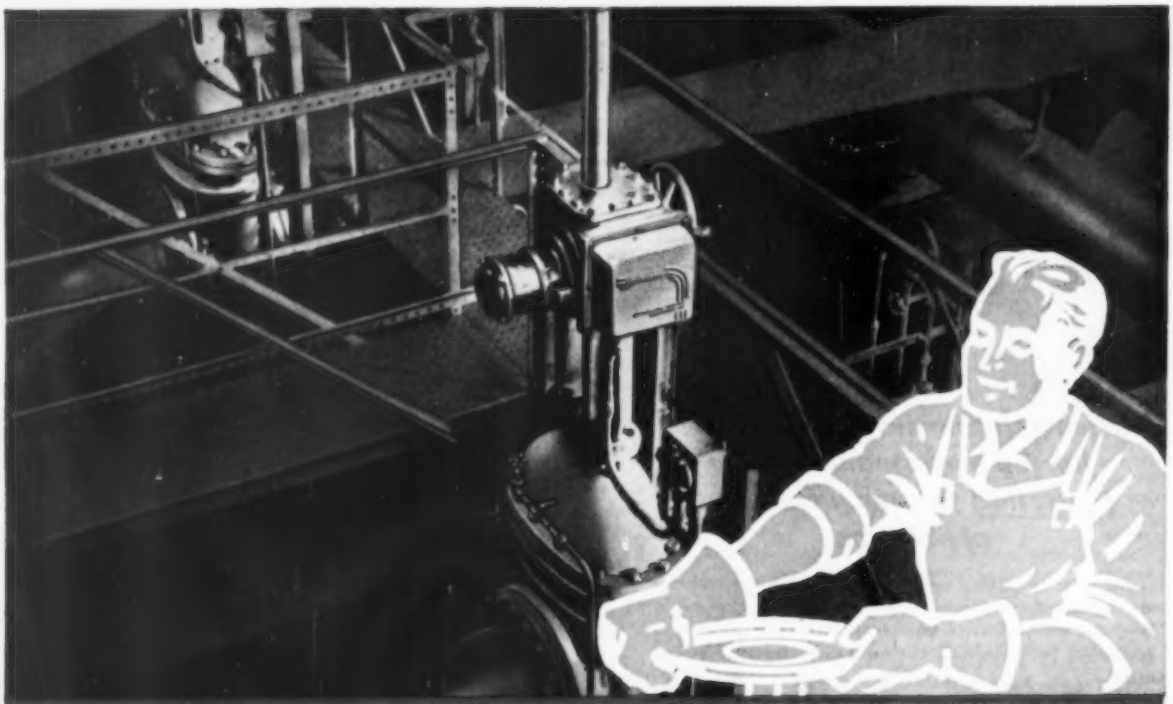
Typical applications are filtering water or solvents; cutting oils, wine and other liquids; reclaiming cleaning fluids; handling industrial oil wastes. Bulletin No. 140 tells you more about Norton ALUNDUM porous mediums.



Norton refractory shapes for reaction furnaces come in bricks, plates, tubes and blocks, made of ALUNDUM, CRYSTOLON, MAGNORITE and FUSED STABILIZED ZIRCONIA refractory materials. The development of FUSED STABILIZED ZIRCONIA is a typical example of how Norton aids you in utilizing higher temperatures for greater efficiency and output. Norton was the first to bring this valuable material out of the experimental stage into commercial production. Now it is used in many processes.

No other refractory is so chemically stable at such high temperatures under both oxidizing and reducing conditions. In gas synthetic processes, furnaces lined with it have withstood temperatures approaching 4700°F for long periods. Its low thermal conductivity (6.2 BTU in dense shapes at 2000°F) and its high electrical conductivity at high heat are other important properties, all of which are described in Bulletin No. 1409.

For more data on advertised products, use Readers' Service Cards, last page.



this man is never missed

WHEN *Limitorque*® IS USED

The familiar sight of a workman climbing around to open or close valves is unnecessary. . . . Now, he *merely pushes a button* at a conveniently located station or a master control panel. . . . Valves operate quickly, dependably and safely. LimiTorque provides complete safety to workmen, by eliminating the need of climbing to out-of-the-way, hazardous locations for manual valve operation; also vitally important, valve operation parts are protected from damage by the automatic shutting-off of the motor if an obstruction is encountered. LimiTorque may be actuated by any available power source . . . electricity, air, water, gas, or oil.

Thousands of LimiTorques are in daily use, in Power Plants, Water and Sewage Plants, Chemical and Process Plants, Paper Mills, Oil Refineries, Oil and Gas Pipe Lines, —and on Shipboard. LimiTorque Motor Operated Valves are readily adapted to Microwave Control.

Write for LimiTorque Catalog L-54 for further details.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

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WHAT Vogt CAN DO FOR YOU..

Bulletin E-1 shows Vogt's advanced designs in heat exchangers, reactors, oil chillers, crystallizers, pressure vessels, steam generators and ice making and refrigerating machinery for countless applications in petroleum refineries, chemical plants, power plants and related industries.

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EASY TO SERVICE...

a plus value of ASHCROFT *Maxisafe* DURAGAUGES

Turn the knob on the back of the *Maxisafe* and the plate comes off, fully exposing the entire mechanism for fast and easy inspection, recalibration or adjustment. This time and money-saving feature is highly favored wherever Ashcroft *Maxisafe* Duragauges are in service.

This Duragauge was named *Maxisafe* because it has an integrally-cast wall to separate the dial from the movement and Bourdon Tube assembly — a solid wall of safety that protects the viewer if the tube ever ruptures. Covering the back of the case is a double spring mounted safety release plate — a Teflon-coated plate tightly fitted on a rubber gasket and held in place by a knurled knob. Less than 0.5 psi pressure created by a ruptured tube forces this cover open — vents the discharge safely to the rear.

The Maxisafe is available in 4½", 6" and 8½" dial sizes. You can have a choice of standard Ashcroft Duragauge pressure ranges, case designs (except Types 1179 and 1279), and mountings. Get the utmost in sustained accuracy, durability, protection and convenient servicing. Specify Ashcroft *Maxisafe* Duragauges.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has complete facts about Ashcroft Gauges of all types. You can depend on his knowledge and experience to help you satisfy every requirement of the application. He maintains local stocks to serve you promptly and economically.

ASHCROFT 1850 U.S.A.

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

An important message concerning a new —and unique— alloy steel

UNITED STATES STEEL is pleased to announce to all steel consumers a new steel which we feel sure will enable you to improve the performance, lengthen the life, and reduce the cost of industrial equipment. This new engineering material is USS Carilloy T-1 steel, which recently underwent some very severe testing in Birmingham, Alabama.

The development of T-1 steel began back in 1947, when our research people took a good look at a problem that had plagued alloy plate steel users for years. That problem was the multiplicity of compositions required to do everyday jobs. There was no one composition available that could serve a wide variety of applications—so our research people set out to develop such a steel. The steel we wanted had to possess many unusual attributes such as very high strength, unusual toughness, good weldability and excellent resistance to impact abrasion at temperatures from minus 150°F. up to as high as 900°F.

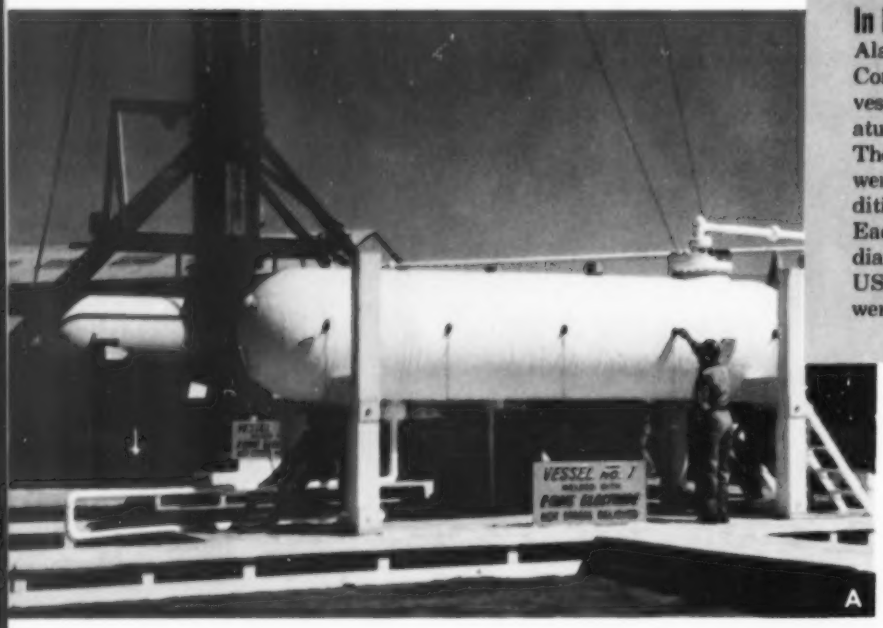
Today such a steel is a reality. It is USS Carilloy T-1 steel, which has been tested thoroughly, both in the laboratory and in actual service applications. To prove further the capabilities of this new Carilloy steel, Chicago Bridge & Iron Company and United States Steel this summer carried out a joint testing program on commercial pressure vessels built from T-1 steel. The results of these tests and their significance to all steel users are described on the next three pages. We feel sure that you will find the story well worth reading.

USS TRADE MARK

UNITED STATES STEEL

Remarkable new engineering material

PROVES SUPER-TOUGH



A

In May and June, 1954, at the Birmingham, Alabama, plant of Chicago Bridge & Iron Company, eight welded cylindrical pressure vessels were refrigerated to subzero temperatures and deliberately tested to destruction. The vessels were all standard designs that were built under normal production-line conditions by Chicago Bridge & Iron Company. Each vessel was twenty feet long, four feet in diameter, and made of half-inch plates of USS Carilloy T-1 steel. Four of the vessels were welded without stress relieving, using

B

In pressure test at 38°F. below zero T-1 steel withstands stresses 3 times its design strength

This vessel, not stress relieved, was refrigerated to —45° F. Then, with a quarter inch of white frost clinging to its sides, a high pressure pump slowly chugged the pressure in the vessel up to 938 psi. At that point, the steel itself was stressed to 45,000 psi., which is one half the yield strength of T-1 steel.

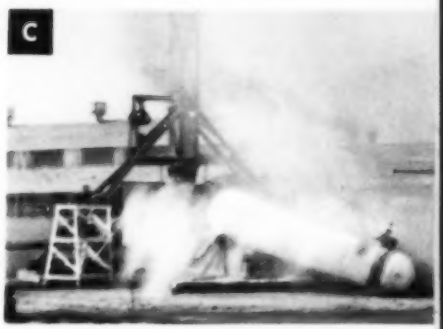
The hydraulic pressure was forced still higher, to 1875 psi. At this pressure, the stress in the steel had reached 90,000 psi.—the full *nominal* yield strength. Still, every inch of the metal was sound and all welds were intact.

Now the test really came. The pump labored on, and the pressure climbed to 2,000 psi. . . . to 2500 . . . to 2850 psi. . . . then . . .

BOOM! A jet of yellow brine burst out of the vessel and shot 200 feet through the air. The vessel finally failed at a pressure of 2850 psi. and a minimum stress of 136,000 psi. on the plates. This stress is well over three times the design strength of 45,000 psi.

The temperature of the steel at the time of failure was a frigid 38 below, yet the metal showed no sign of brittle failure. Super-tough USS Carilloy T-1 did what no ordinary steel could do at such a low temperature—it stayed *tough and ductile;* in fact it actually stopped the tear from propagating any further through the vessel.

C



D

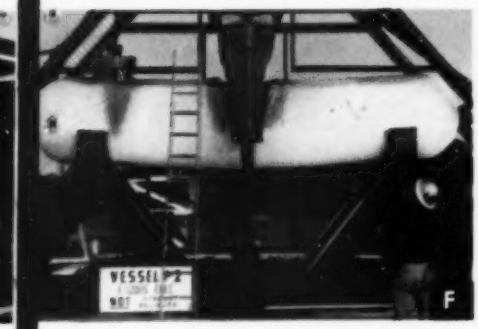
UNITED STATES STEEL

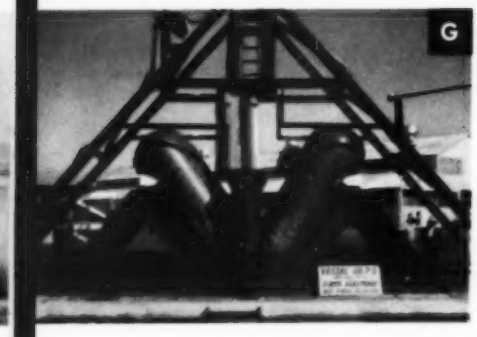
USS CARILLOY T-1 STEEL

DOWN TO 38°F. BELOW ZERO

E 12015 low hydrogen coated electrodes. The other four were welded with E 9015 electrodes and were stress relieved after welding. Two vessels of each type were given two tests: a pressure burst test for strength and ductility, and an impact punishment test for toughness and resistance to the most severe impact conditions that could be devised.

Results of these tests, described below, prove conclusively the exceptional strength and toughness of USS Carilloy T-1 steel, even at temperatures far below freezing.





Frozen steel vessel made of Carilloy T-1 survives blow from 13-ton ingot dropped 73 ft.

A steel ingot weighing 26,700 lbs. has just plummeted 52 feet and crunched on top of this test vessel (Fig. E). The ingot was traveling 39 miles per hour when it hit. It struck with an impact energy of about 1,400,000 ft. lbs., bounced fifteen feet, and crushed down again on top of the vessel.

This vessel was welded without stress relieving. It was refrigerated to 33°F. below zero. It was pressurized to 1,875 psi. equal to a stress on the plates of 90,000 psi.—the steel's *nominal* yield strength. Yet, it did not fail. The ingot left only a $\frac{7}{16}$ inch dent in the top, with a slight bulge on either side of the dent.

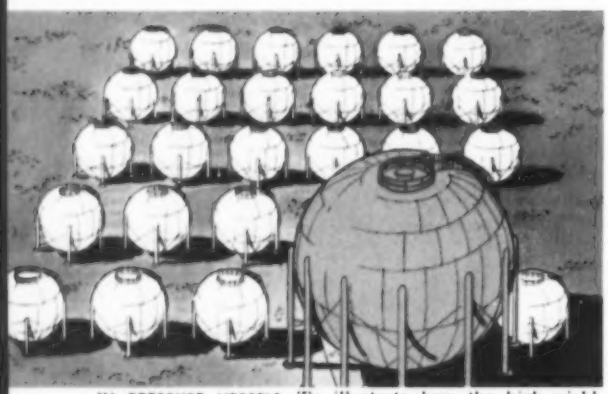
The test was repeated (Fig. F). This time the ingot was raised 73 feet, then dropped. It pounded down again on the very same spot on top of the vessel. Traveling at 46.7 miles per hour, it hit with an impact blow of 1,960,000 ft. lbs. The dent merely deepened – the steel and all welds were still intact.

Again the test was repeated (Fig. G). Now dropped from 101 feet, the 13-ton ingot ploughed into the top of the vessel at a speed of 55 miles per hour, hit with an impact of 2,750,000 ft. lbs. This time the vessel failed. But it didn't shatter. It didn't crack. It tore open like a tough piece of hickory. In other words, it failed without any signs of brittleness, even though the temperature of the steel was now minus 22°F.

In addition to this tremendous resistance to impact abuse, combined with remarkable sub-zero toughness, Carilloy T-1 steel also gives you excellent resistance to impact abrasion . . . good high temperature strength . . . and exceptional weldability.

Turn the page to see how you can use this remarkable new steel to cut costs and improve performance in a great variety of products.

Here's where you can reduce costs with USS Carilloy T-1 steel



IN PRESSURE VESSELS. To illustrate how the high yield strength of Carilloy T-1 steel can pay off here, consider this fact: To store 25,000 bbls. of propane at 210 psi would ordinarily require 25 mild carbon steel vessels. In contrast, only *one* large vessel made of T-1 steel of the *same* thickness would do the job. This single T-1 vessel would require 1/3 less shell material, 14% less foundation concrete, 70% less welding and 84% less space.

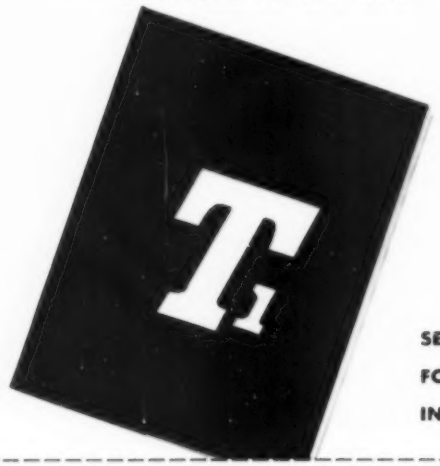
IN STEEL MILLS. In skip cars, T-1 steel in the bottoms, sides, and bail plates lasts three times longer than steels now in use. T-1 steel also gives exceptionally long service in coke bins and chutes, in ore transfer cars, in draft lines, in conveyor chains, and crane hooks. In clamshell buckets, T-1 steel has taken heavy abuse at temperatures from 500° to 600° F. and lasted *nine times* as long as the wear resisting steel previously used.

IN EXCAVATING EQUIPMENT. The dipper stick, bail, and bucket of this big electric shovel are fabricated of T-1 steel plate. The superior strength and durability of Carilloy T-1 made it possible to increase the capacity of the bucket from 35 to 45 cu. yds.

• The pressure vessel tests described on the previous pages indicate only one of the many possible uses of Carilloy T-1 steel. For this new engineering material has advantages not only in pressure vessels and storage tanks, but it also has proved itself in power shovels, bulldozers, mining machines, mine cars, steel mill ladles, blast furnace draft lines, lift trucks—in high speed rotating machinery, in stamping or forging presses. It is being considered for use in tension members of cantilever bridges and other similar applications where tension members are involved.

With the 90,000 psi. minimum yield strength to work with, combined with extraordinary sub-zero toughness, good high temperature strength to 900° F., and excellent resistance to impact abuse, impact abrasion, and atmospheric corrosion, you can use T-1 steel to reduce the size and weight of heavily stressed parts. This cuts your shipping and handling costs, as well as the cost of material, and the cost of foundations and supports where they are needed. Carilloy T-1 steel lengthens the life of your equipment, cuts repair bills and outage time. And remember, wherever you use T-1, you can weld or flame cut it either in the shop or in the field without expensive heat treating equipment. This cuts costs still further.

UNITED STATES STEEL CORPORATION, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK



SEND COUPON FOR COMPLETE INFORMATION.

United States Steel, Room 4481
525 William Penn Place
Pittsburgh 30, Pa.

☐ Please send me your booklet "United States Steel presents T-1" which contains the full story of T-1 steel.

☐ Have your representative get in touch with me.

Name .....

Address .....

City ..... State .....

USS

UNITED STATES STEEL

CAN TYPE VERTICAL PUMP

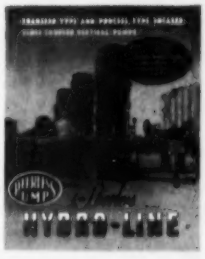
Now Available in Two Types—FOR APPLICATION to CHEMICAL PROCESSING, REFINING TECHNIQUES, CONDENSATE SERVICE, AND LINE BOOSTER SERVICE

NEW DESIGNS PROVIDE BOTH A PROCESS TYPE AND A TRANSFER TYPE

The process type vertical Hydro-Line pump, especially suited to refining and process pumping offers the following features—1) API-ASME code welding; 2) especially designed containers for either mechanical shaft seals or packing; 3) availability of head and barrel flanges up to 300 lbs. or more; 4) extra heavy wall thicknesses for maximum stability and high safety factor; 5) elliptical barrel bottom design for optimum fluid entrance conditions. The transfer type Hydro-Line pump is of a similar design to the process type differing in materials of construction required for less rigorous service. Both types are extremely flexible in installation, are easy to inspect, service and maintain—can be designed for operation on any available system NPSH. Write for new Bulletin No B-1700.

THE PEERLESS
HYDRO-LINE
ENCASED CLOSE-COUPLED PUMP

CAPACITIES TO	3000 gpm
HEADS TO	1000 feet
DRIVES	As required, vertical solid shaft, or explosion-proof motors; steam turbine.
TEMPERATURES	Up to 400° F.



PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories at: Los Angeles, Calif., and Indianapolis, Ind.
Offices: New York; Atlanta; Chicago; St. Louis; Indianapolis; Phoenix; Fresno; Los Angeles; Dallas, Plainview and Lubbock, Texas; Albuquerque, New Mexico.
Distributors in Principal Cities; Consult your Telephone Directory.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Please send me a copy of Peerless Hydro-Line Pump Bulletin No. B-1700.

NAME _____

ADDRESS _____

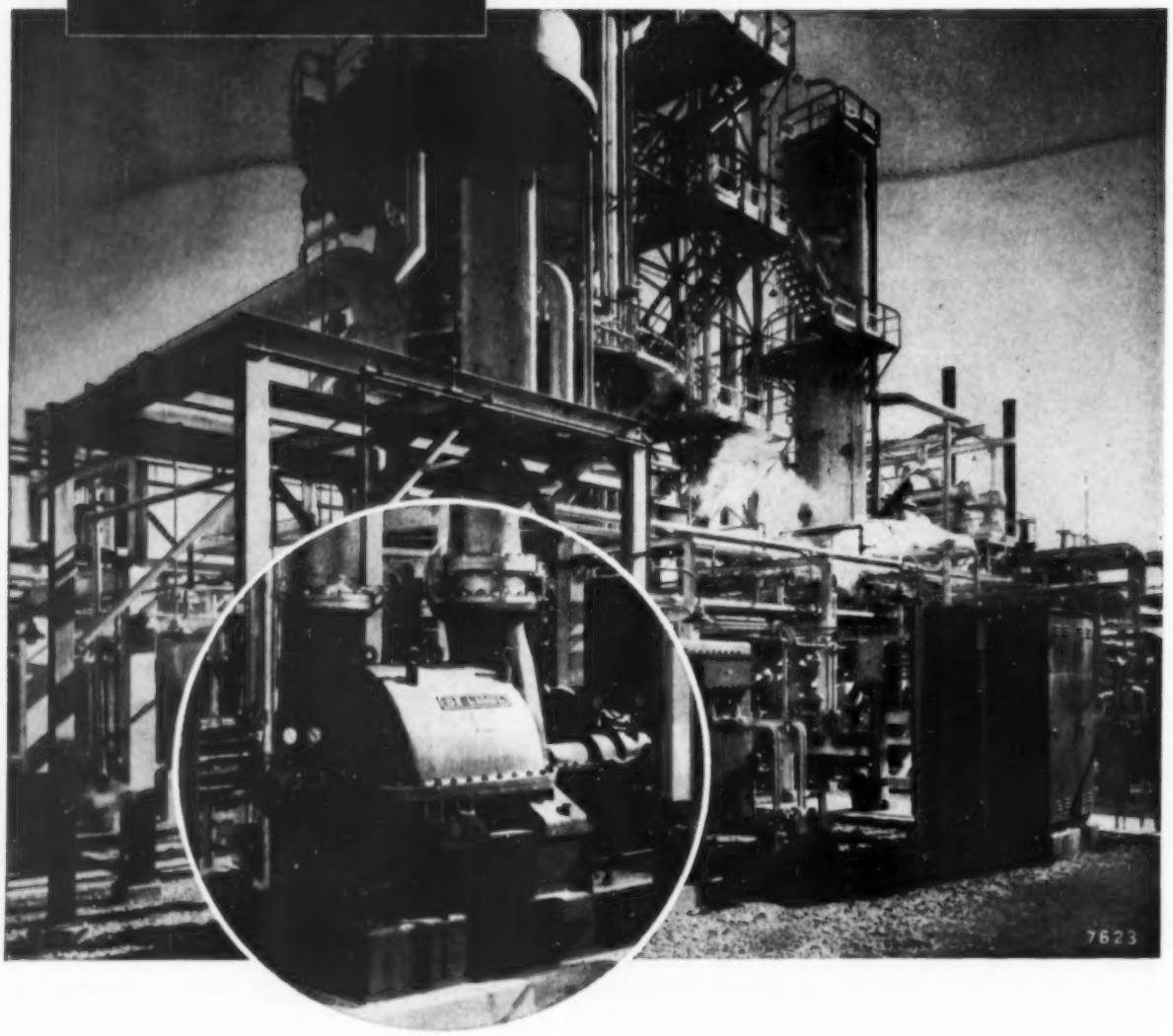
TOWN _____ STATE _____

Pet. Refiner

For more data on advertised products, use Readers' Service Cards, last page.

DE LAVAL
CENTRIFUGAL
BLOWER

delivers 17,400 cfm for Elreco's new cat



This De Laval Centrifugal Blower, on stream at the El Dorado Refining Company's new cat cracker at El Dorado, Kansas, supplies 17,400 cubic feet of air per minute for regeneration of the spent catalyst.

This plant, built in record time of ten months by The Refinery Engineering Company, is designed for a charge capacity of 4,300 barrels per day at 75% conversion.

Elreco is another of many refineries which have chosen De Laval for dependable blower performance under heavy-duty, continuous operation. Rugged casings, husky, perfectly balanced rotor and externally mounted, cylindrically seated bearings are design features that reduce maintenance and insure long service. Send for Bulletin 0500 containing complete data.

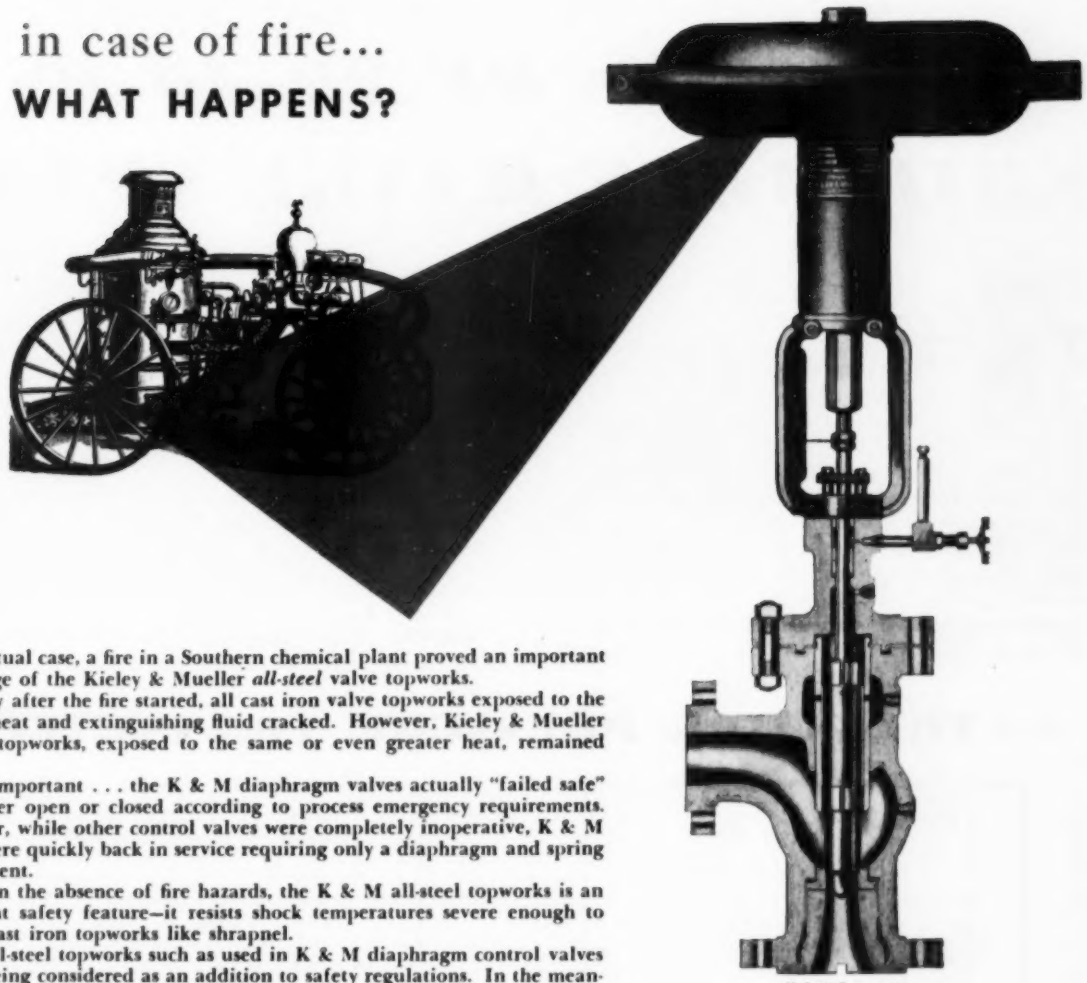
DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY

811 Nottingham Way, Trenton 2, New Jersey

DL 807

in case of fire...
WHAT HAPPENS?



In an actual case, a fire in a Southern chemical plant proved an important advantage of the Kieley & Mueller *all-steel* valve topworks.

Shortly after the fire started, all cast iron valve topworks exposed to the intense heat and extinguishing fluid cracked. However, Kieley & Mueller all-steel topworks, exposed to the same or even greater heat, remained intact.

Most important . . . the K & M diaphragm valves actually "failed safe" . . . either open or closed according to process emergency requirements. Moreover, while other control valves were completely inoperative, K & M valves were quickly back in service requiring only a diaphragm and spring replacement.

Even in the absence of fire hazards, the K & M all-steel topworks is an important safety feature—it resists shock temperatures severe enough to shatter cast iron topworks like shrapnel.

The all-steel topworks such as used in K & M diaphragm control valves is now being considered as an addition to safety regulations. In the meantime, you can have this essential safety factor, along with all the other design advantages of Kieley & Mueller diaphragm control valves, such as the highest flow capacity and maximum linearity of response, at no additional cost.

FOR THE COMPLETE FACTS . . . write for the K & M Valve Engineering Data Catalog, Bulletin CV53.

K & M Type 1460
Sweep Flow Angle Valve
for slurries and flashing liquids

diaphragm control valves

KIELEY & MUELLER, INC.

K&M

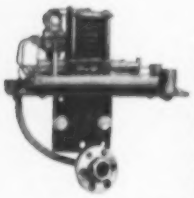
Valve Makers
Since 1879

64 Genung Street
Middletown, New York

For more data on advertised products, use Readers' Service Cards, last page.

Now you can measure pressures

WITHIN ½% OF 20-40 PSI SHIFTABLE RANGE SPANS



The Taylor TRANSAIRE* Pressure Transmitter with short, shiftable spans gives accuracy and sensitivity never before thought possible—plus the convenience of suppressed ranges at high pressure levels. Operating on the simple force-balance principle, it lets you measure and transmit minute pressure changes up to 1,000 ft. It's accurate to ½% of the selected short range span, as against an accuracy of up to ½% of the upper range limit of conventional devices. On control applications such accuracy of measurement produces a remarkable difference in product quality and yield. It's sensitive to pressure changes of ½" water.

THREE IMPORTANT ADVANTAGES

1. Range spans of 20 and 40 psi are available throughout the range limits of 35 to 415 psia; 50 to 100 psi throughout 100 to 1,000 psia.

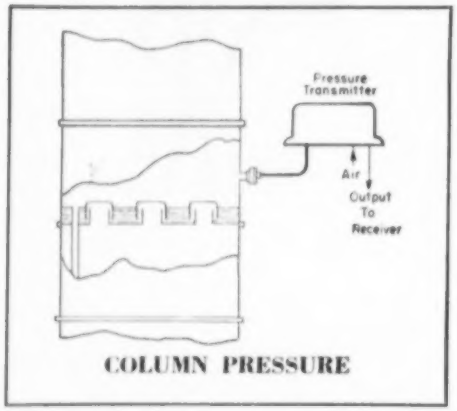
2. The volumetric type pressure system is extremely accurate, practically clog-proof, has a corrosion-resistant 316 stainless steel diaphragm.

3. Temperature and barometric compensation makes for higher accuracy of measurement, and consequntly closer control.

• • •

Ask your Taylor Field Engineer, or write for **Bulletin 98097.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

TRANSAIRE PRESSURE TRANSMITTER



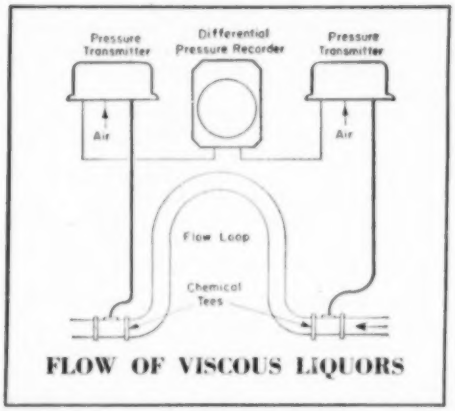
COLUMN PRESSURE

NARROW RANGE SPAN DETECTS PRESSURE TRENDS

Problem: To get highest possible purity of product consistent with good production economy. This requires the quick detection of pressure trends over a very narrow range.

Solution: The short, shiftable range spans (as short as 20 psi) of the TRANSAIRE Pressure Transmitter permit selection of operating range by a simple screwdriver adjustment. Its high order of sensitivity enables the operator to detect minute changes of pressure.

Result: Close control, because the minute pressure trends are practically instantaneously detected and transmitted to the controller and receiver. This means higher yield of a purer product, also great flexibility in changing to different product requirements.



FLOW OF VISCOUS LIQUORS

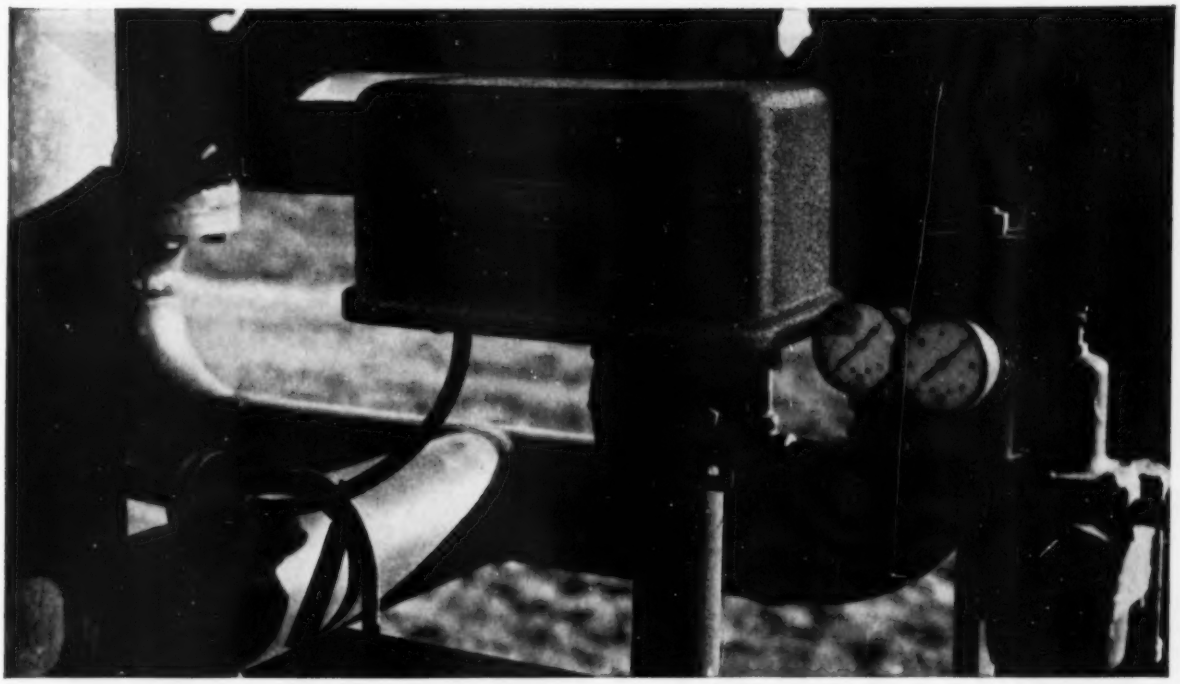
STREAMLINED SURFACE PREVENTS SCALE, SOLIDIFICATION

Problem: Flow measurement of viscous material which tends to solidify when static, making conventional differential producers impractical.

Solution: Its flush element presents a streamlined surface and tends to prevent formation of scale or solidification of liquors. Its short range, high sensitivity and volumetric construction make the TRANSAIRE Pressure Transmitter ideal for this application.

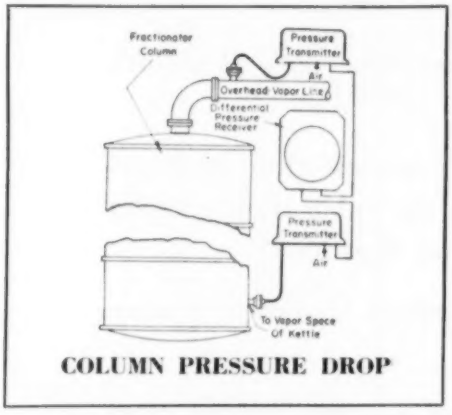
Result: Trouble-free, accurate measurement and control of flow. One installation has given continuously satisfactory service for four years.

*Reg. U.S. Pat. Off.



Typical installation of a TRANSAIRE Pressure Transmitter on a distillation column. Note close-coupled connection in field. Receiver may be several hundred feet away.

SOLVED THESE FOUR TOUGH PROBLEMS



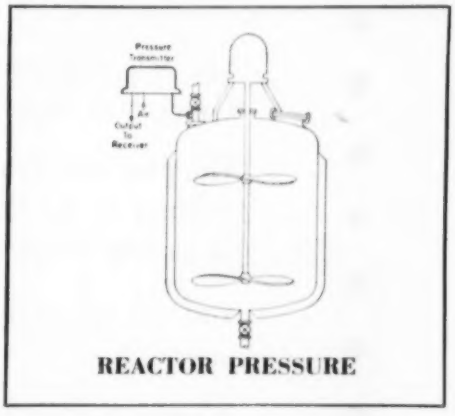
COLUMN PRESSURE DROP

PERMITS MAXIMUM CAPACITY OPERATION

Problem: To operate a column at maximum capacity, consistent with the preventing of flooding.

Solution: As the pressure drop across the column is a measure of the vapor velocity, the measurement of this drop with a short-range, highly sensitive, easily adjustable instrument enables the operator to keep the column safely close to the flooding point.

Result: Maximum production and uniform operation.



REACTOR PRESSURE

FLUSH SURFACE IS CLOG-PROOF

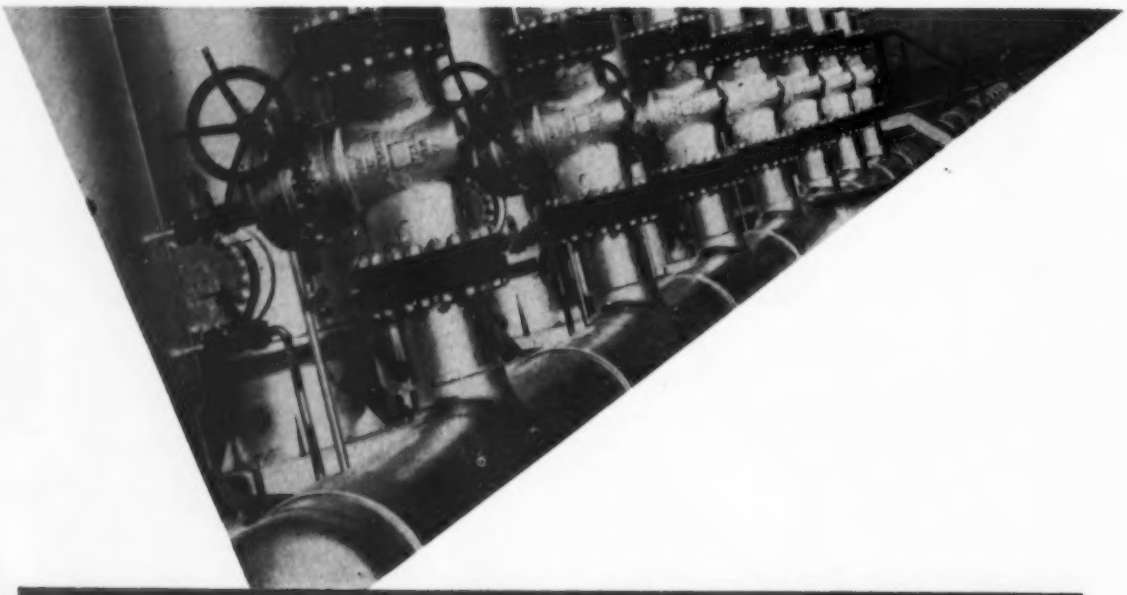
Problem: To measure pressure in reactor kettles containing viscous or corrosive liquids which tend to clog conventional measuring systems.

Solution: The closed volumetric measuri ,g system of the TRANSAIRE Pressure Transmitter presents a flush surface on the inside of the vessel. It is clog-proof, highly sensitive and provides an accurate reading.

Result: Maximum yield of high purity product and a precise knowledge of the pressures maintained.

Taylor Instruments MEAN ACCURACY FIRST

For more data on advertised products, use Readers' Service Cards, last page.



WALWORTH

All-Purpose Plug Valves

You get a positive seal every time with Walworth Lubricated Plug Valves.

The plug in a Walworth is always seated in the body; nothing in the line prevents the valve from opening or closing – and a quarter-turn does it.

You can tell at a glance whether a Walworth is open or closed.

Walworth Plug Valves are so completely satisfactory for so many types of work that they have come to be known as "all-purpose" valves.

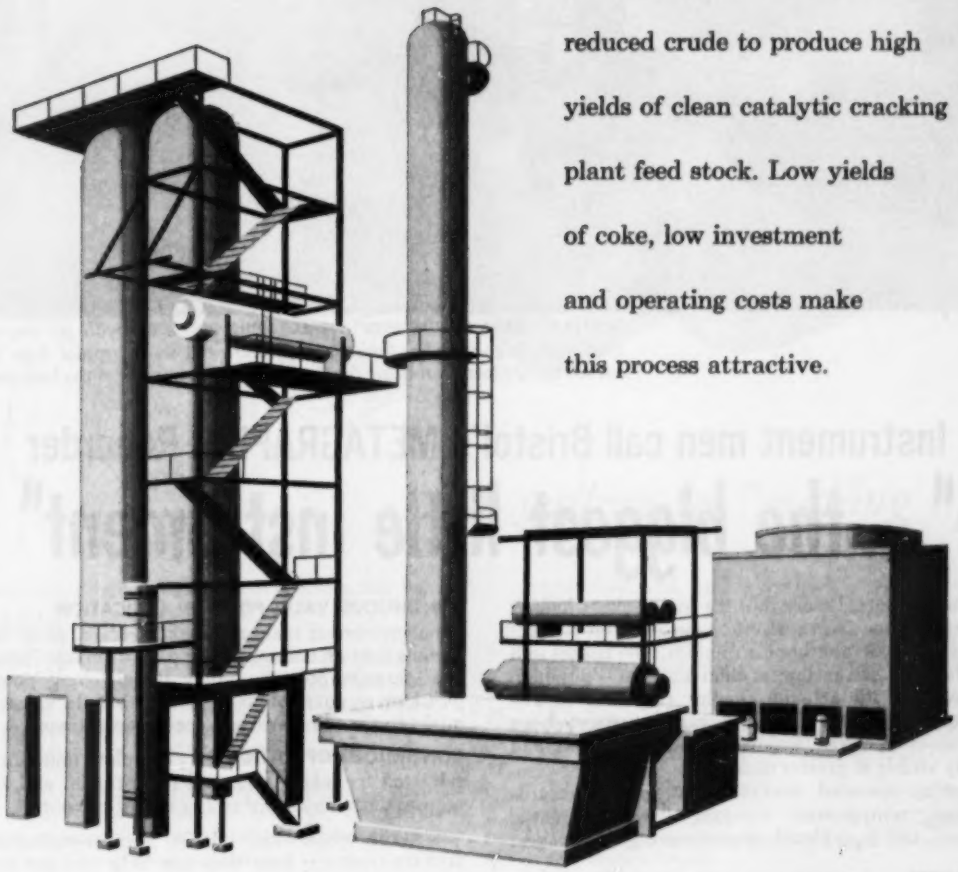
J&L STEEL

Jones & Laughlin
STEEL CORPORATION
SUPPLY DIVISION – TULSA, OKLAHOMA
Serving The United States and Canada

P·E·S·A
PARTNERS IN PETROLEUM PROGRESS

Blaw-Knox decarbonizing process

. . . a simple means of processing reduced crude to produce high yields of clean catalytic cracking plant feed stock. Low yields of coke, low investment and operating costs make this process attractive.

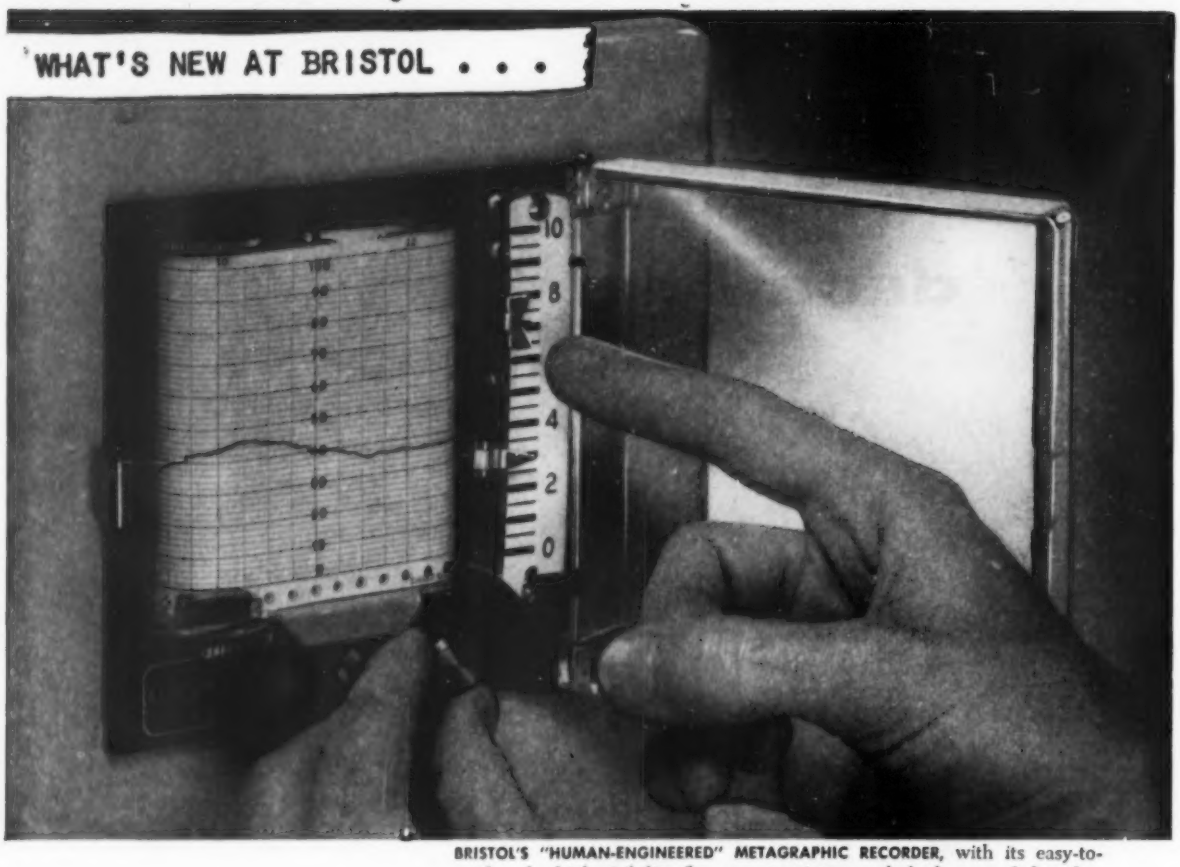


BLAW-KNOX

BLAW-KNOX COMPANY

Chemical Plants Division
Tulsa 1, Oklahoma
Pittsburgh 22, Pennsylvania / Chicago 1, Illinois

For more data on advertised products, use Readers' Service Cards, last page.



BRISTOL'S "HUMAN-ENGINEERED" METAGRAPHIC RECORDER, with its easy-to-read scale, high-visibility fluorescent pointers and shadow-proof door has earned the distinction of being the "biggest little instrument in the business."

Instrument men call Bristol's METAGRAPHIC Recorder

"... the biggest little instrument"

Sounds contradictory, but it's true. Take a look at one of our new METAGRAPHICS mounted on a panel board alongside of other instruments. The Bristol unit stands out – seems bigger than the rest – although chances are it's actually smaller (5" x 5¾"). The answer is that the Bristol instruments have been "human-engineered", making them easy to read, and clearly visible at greater distances.

The air-operated METAGRAPHIC, which records pressure, temperature, vacuum, flow, differential pressure, and liquid level, offers these big advantages:

SIMPLICITY . . . fewer moving parts, fewer adjustments, and less service required. Range changes can be made in seconds. True plug-in service.

CONTINUOUS VALVE-POSITION INDICATION . . . on same instrument scale as set-point scale, gives continuous data on control valve position—makes "bumpless" transfer possible simply by matching pointer positions – no need to read actual scale values – minimizes reading errors – speeds operations.

CONTINUOUS OPERATION . . . complete unit can be retracted for inking pen, and for set-point and zero adjustment without disturbing record or control.

Get the whole story on the "human-engineered" METAGRAPHICS – how they can help you get more accurate measurements, faster and easier. Write us today. The Bristol Company, 111 Bristol Road, Waterbury 20, Conn.

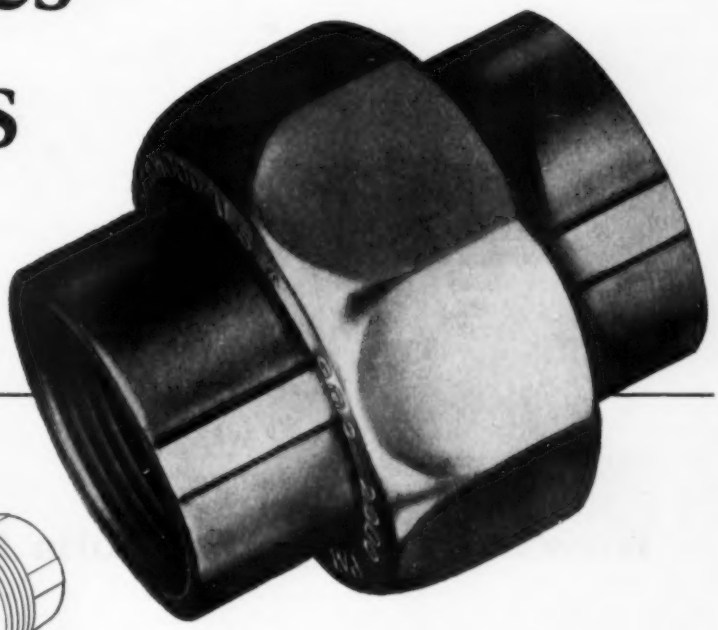
4.4

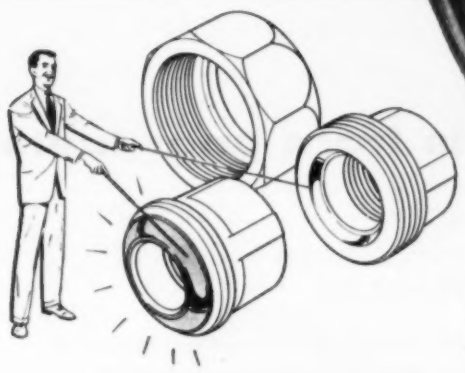
BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

For more data on advertised products, use Readers' Service Cards, last page.

Unique performance
of new Rockwood Union #603
amazes users





No galling in "making up"!

"There's no other Union like it!" users tell us.

And they're quite right.

No other Union has the hardness-differential that makes Rockwood's remarkable new Union #603 unique. *The male seat of this new Union is specially treated to give it a greater degree of hardness than the female seat.* Result: no galling in "making up" — longer service.

Users find that this hardness-differential, coupled with the many other Rockwood features, brings them Union performance unheard of before. They also praise these additional Rockwood advantages —

- √ exclusive cold forging process that results in higher resistance to tough working conditions
- √ absolutely interchangeable parts
- √ plug type ball-to-cone design that eliminates sharp corners or edges, does away with scratching when making up in tight places
- √ exclusive "Rockwoodizing" that protects entire Union, including threads, against corrosion

Both seats of the new Union #603 are made of corrosion-resistant AISI molychrome steel, forged in place and bonded-locked under 100,000 and 400,000 pound pressure.

If you have not already started using this remarkable new Union, plan now to do so. For complete facts, mail coupon today.

ROCKWOOD SPRINKLER COMPANY
WORCESTER 5, MASSACHUSETTS

ROCKWOOD

ROCKWOOD SPRINKLER COMPANY
649 Harlow Street
Worcester 5, Mass.

Please send me prices and further data on the new Rockwood Union #603. I would also like the name of the nearest Rockwood distributor.

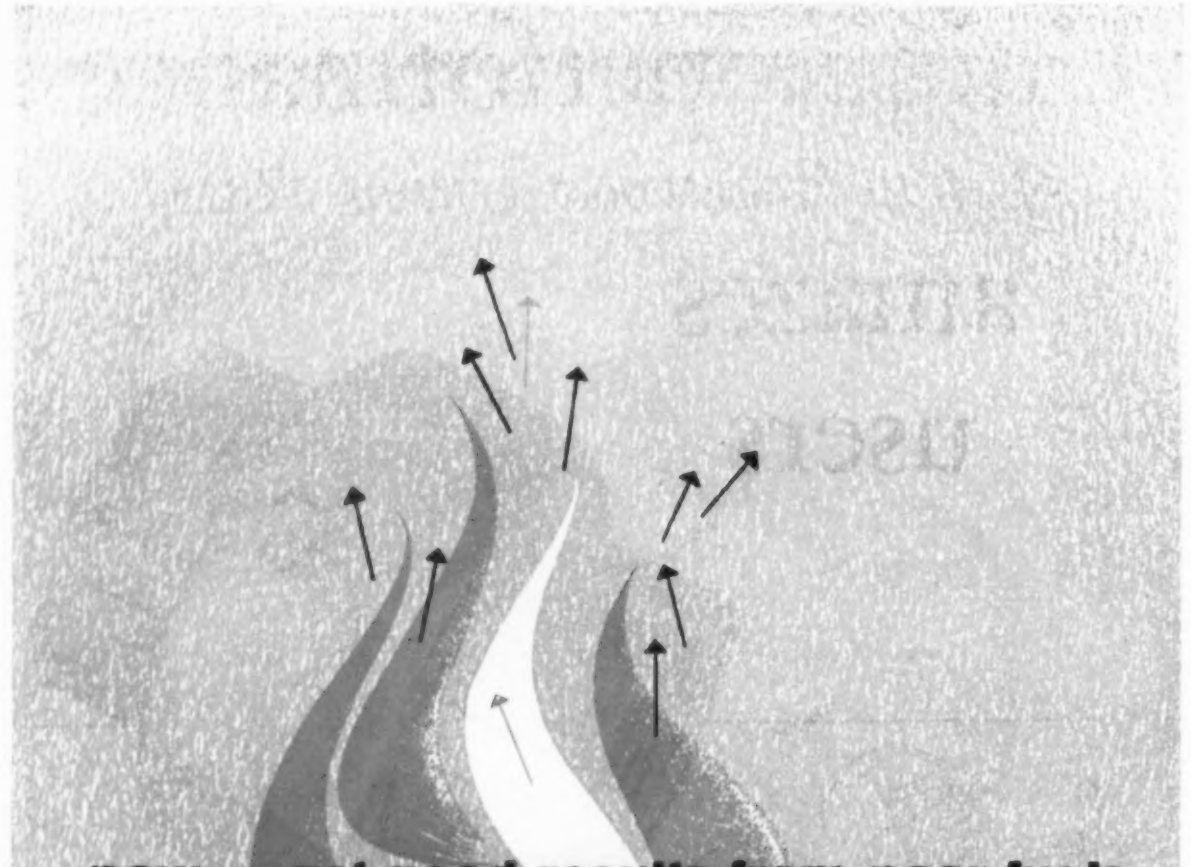
Name.....

Title.....

Company.....

City.....Zone.....State.....

For more data on advertised products, use Readers' Service Cards, last page.



now... get good results from poor fuels

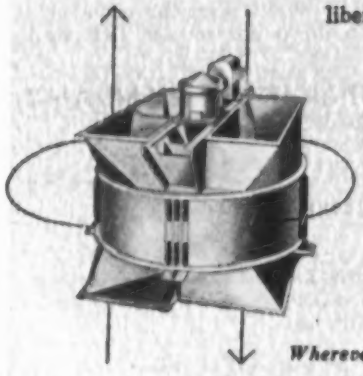
...with Ljungstrom Air Preheaters

Use a *Ljungstrom® Air Preheater* on your fuel-fired units, and you'll be able to burn even such former wastes as low-grade tars, pitches and asphalts — *efficiently.*

That's because preheated air leads to efficient combustion by causing faster ignition and a short, hot flame . . . and higher rates of heat liberation. When you preheat your combustion air, excessively lean fuels . . . or fuels with high ash or moisture content — become practical commercial fuels.

And don't forget — using a Ljungstrom means you'll have lower fuel costs . . . greater throughput . . . higher product quality. You'll even be able to design furnaces that cost less initially. Lump these savings together, and you'll find that your Ljungstrom Preheaters *pay for themselves in just a few months.*

So, wherever you are planning a new fuel-fired process unit . . . or modernizing an old one . . . look to Ljungstrom for the practical, modern way to keep costs down. Write today for full information.



Wherever you burn fuel, you need Ljungstrom

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

WILFLEY
ACID PUMPS

for HCl

$CuCl_2$

$FeCl_2$

H_2SO_4

NaOH

KCl

and other solutions

These are the pumps with the enviable reputation for efficiency. They operate without attention, delivering trouble-free, cost-reducing performance on "'round-the-clock" schedules.

Available with pumping parts of the machinable alloys, as well as plastic, to meet all requirements. Individual engineering on every application. Write or wire for complete details.

Wilfley Model "AF" Pump with wetted parts of durable, corrosion-resistant plastics.

Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
Wilfley Sand Pump

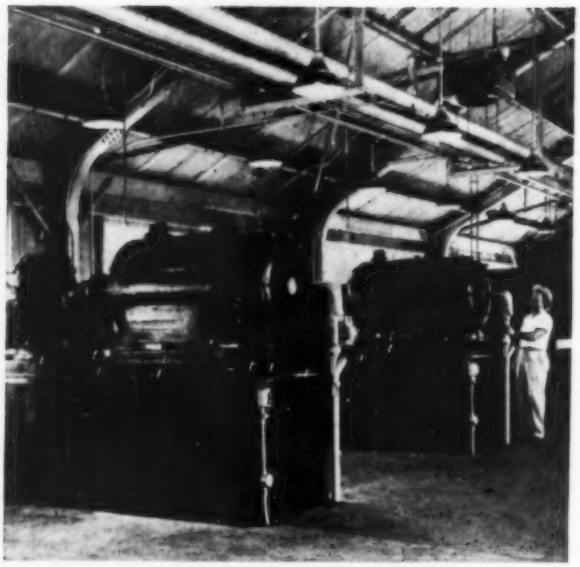
A. R. WILFLEY & SONS, INC. Denver, Colorado, U.S.A.
New York Office: 1775 Broadway, New York City

For more data on advertised products, use Readers' Service Cards, last page.

COMPACT, CENTRALIZED CONTROL PANEL handles high-voltage distribution economically for the entire Eagle Point Refinery operation. Incoming power from both plant generators is distributed to transformer banks, G-E limitamp control and switchgear. Interlocks assure safer operation, proper sequence. All enclosures are metal-clad for maximum protection.

G-E equipment helps Eagle Point

SIMPLE, FLEXIBLE DRIVE CONTROL for power station auxiliaries is provided by this G-E Limitamp panel. It protects motors for service pumps, raw water pumps, air supply apparatus.



FOR GREATER CONTINUOUS PROCESSING SAFETY, G-E motors at Eagle Point are totally enclosed, explosion-proof. Here, motors ranging from 200 to 400 hp drive transfer oil pumps.

ROUND-THE-CLOCK PRODUCTION at Eagle Point is aided by dependable G-E outdoor lighting. This modern plant-wide lighting system allows equipment to be moved quickly, safely. Critical operating areas are brightly lighted to step up efficiency of nighttime operating and maintenance work. Result: maximum output, night and day.

boost output 50% over rated capacity

20,000 barrels a day increase at Texaco's Westville, N.J. refinery aided by co-ordinated General Electric equipment

The Texas Company's Eagle Point Refinery in Westville, N. J. recently hit a production high when it boosted its output 50 per cent over rated capacity. General Electric equipment helped in this production increase—approximately 20,000 barrels of crude throughput a day.

Eagle Point is another of this country's top refineries to use co-ordinated G-E equipment and engineering services. G-E engineers, specializing in refinery applications, helped the Texas Company plan the electrical system, which includes provisions for future plant expansion. High-voltage distribution is one of the system's key features—power is transmitted to substations at 13,800 volts, reducing losses and improving voltage regulation.

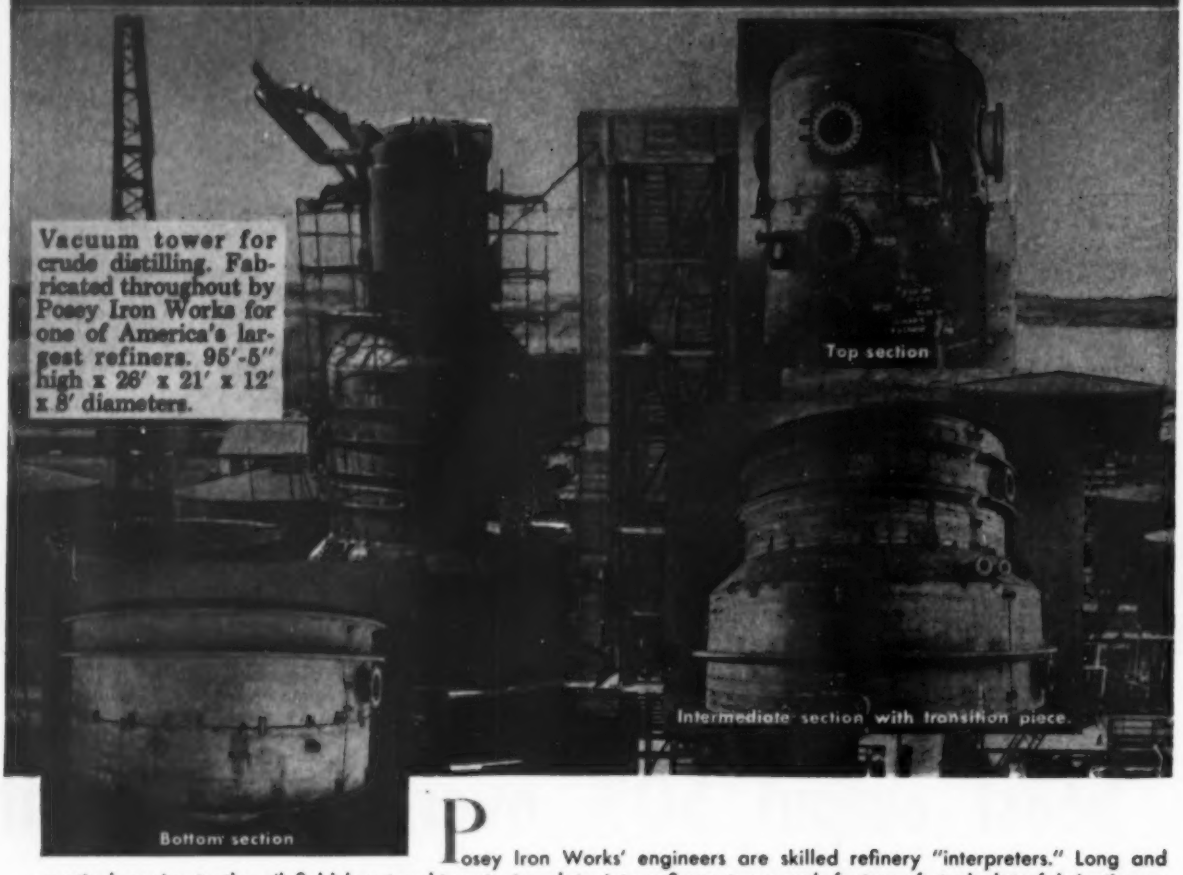
If you are planning to build, expand, or modernize, let a team of G-E engineers help you design an electrical system for top production and flexibility. Contact your nearby G-E Apparatus Sales Office early—during the preliminary planning. General Electric Company, Schenectady 5, N. Y. 661-43

Engineered Electrical Systems for Petroleum Refineries

GENERAL ELECTRIC

For more data on advertised products, use Readers' Service Cards, last page.

SECTIONAL CONSTRUCTION:
Posey Knows It Inside and Out
. . . and From the Oil Man's Viewpoint


Vacuum tower for crude distilling. Fabricated throughout by Posey Iron Works for one of America's largest refiners. 95'-5" high x 26' x 21' x 12' x 8' diameters.
Top section
Intermediate section with transition piece.
Bottom section

Posey Iron Works' engineers are skilled refinery "interpreters." Long and practical service to the oil field has taught us to translate into *refinery* terms such factors of steel plate fabrication as sectional construction . . . loads . . . pressures . . . capacities . . . fire protection requirements . . . steels . . . alloys . . . and specialized structures.

All Posey Iron tanks and vessels are tested to a considerable excess over working pressures. Products are designed and built to comply with the requirements of the ASME; API-ASME; API and other codes. The Posey Iron Works is authorized to apply the appropriate code symbols.

Talk over your steel and alloy steel plate fabrication needs with Posey Iron. You'll find we talk your language.

a new miniature indicator!

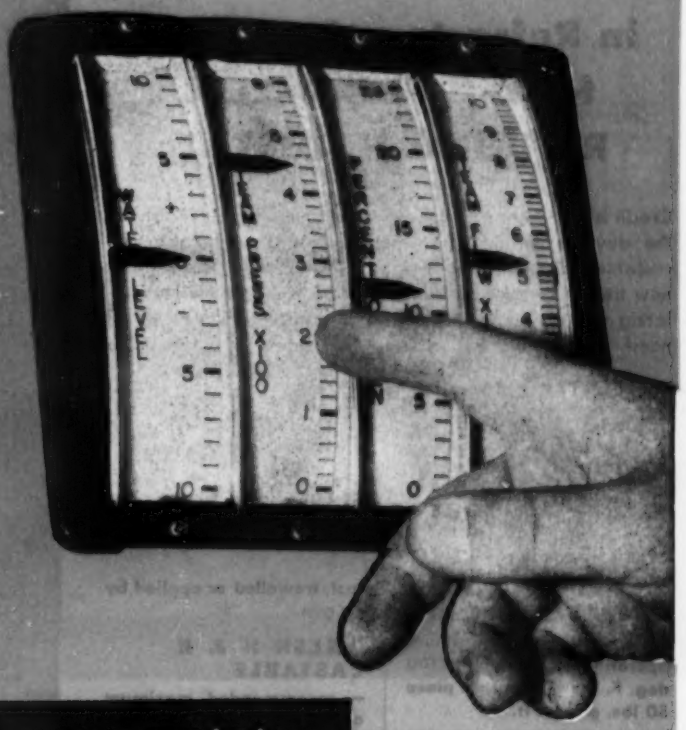
Available with:

MEASURED VARIABLE → AIR-PILOT → COPPER TUBING

PNEUMATIC TRANSMISSION

MEASURED VARIABLE → DIFF. TRANSF. → AMPLI-FIER

ELECTRICAL TRANSMISSION



removable units—interior illumination

easy to read—5 inch scale, no parallax

easy correlation of related functions

easy zero check from the front

HAYS Miniature Indicators

This miniature instrument is especially suited for remote indication of such variables as pressure, draft, flow or level.

The scale is only 5 inches long — easy to read — internally illuminated. Choice of pneumatic or electric transmission.

Also available is the Hays direct reading miniature gage for indicating *pressures* of fluids (steam, water, gas, oil, etc.) directly.

Gages are arranged for flush or semi-flush mounting. Either a yoke mounting, for as many as 12 units, or a keyhole clamp mounting for individual units can be provided.

Write today for full information on the Hays Miniature Indicator Bulletin 52-1075-223.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 10, INDIANA

For more data on advertised products, use Readers' Service Cards, last page.

REACHING A NEW
in Refractory Castables for the PETROLEUM REFINING INDUSTRY

Credit better research and ceramic engineering at Walsh for the development of these performance-proved refractory castables for the refining industry. Geared to industry's great new trend toward modernization, there is a light weight insulating or high temperature service type to meet your exact need. Write today for details.

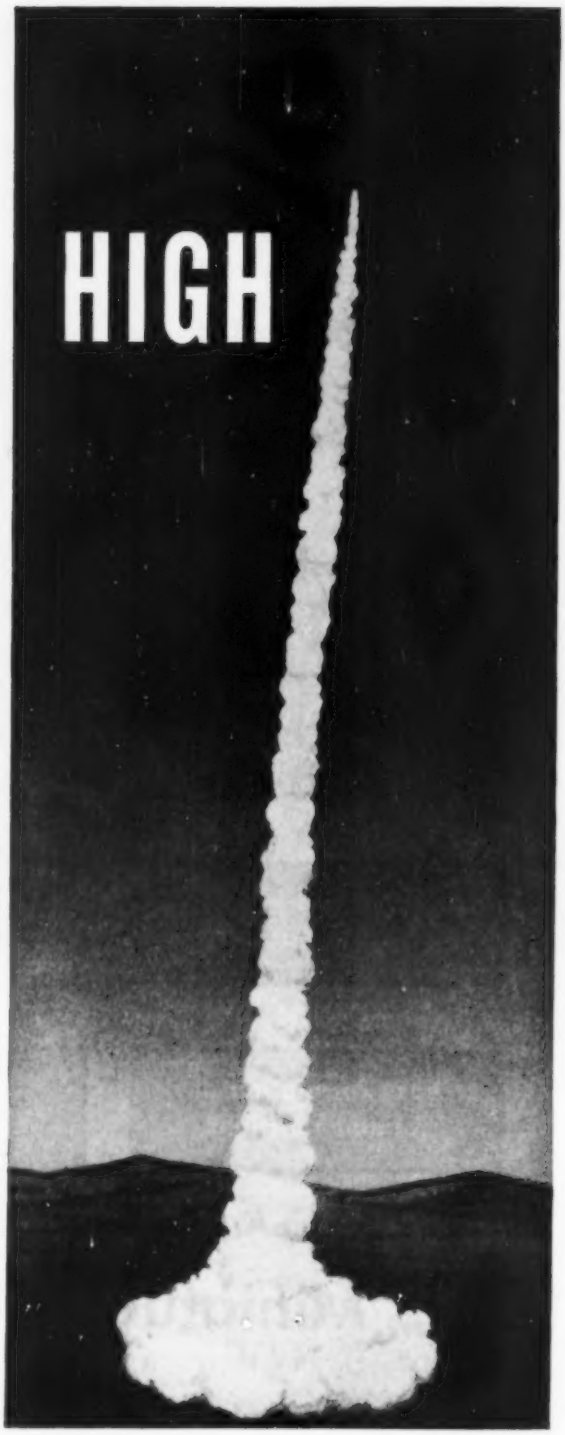
WALSH LITE-WATE CASTABLE NO. 50
— recommended maximum operating temperature 2100 deg. F. Weight, dry, in place 50 lbs. per cu. ft.

WALSH LITE-WATE CASTABLE NO. 70
— recommended maximum operating temperature 2300 deg. F. Weight, dry, in place 70 lbs. per cu. ft.

75% more resistant to heat flow than fire brick. Can be cast, trowelled or applied by air gun.

WALSH H & B CASTABLE
— recommended maximum operating temperature 2700 deg. F. Weight, dry, in place 130 lbs. per cu. ft. For use in forming monolithic linings in fluid catalytic cracking refinery units, for monolithic burner baffles, ash hopper linings, burner blocks, inspection door linings, flue and stack linings, miscellaneous special shapes.

WALSH SUPER CASTABLE NO. 32
—recommended maximum operating temperature 3000 deg. F. Weight, dry, in place 125-130 lbs. per cu. ft. For use in powdered coal and oil burner ports, monolithic linings in high temperature furnaces, special shapes.

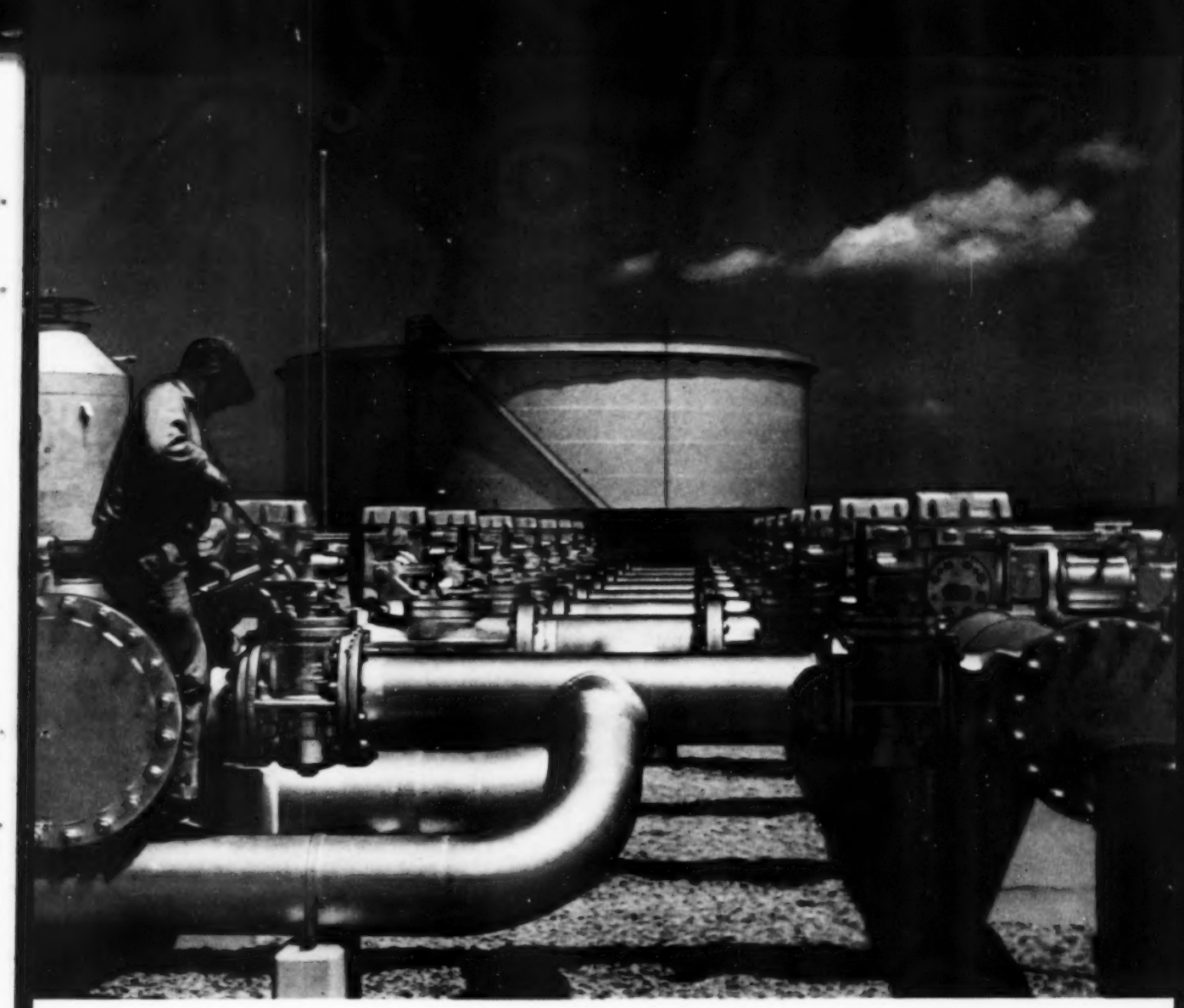


WALSH REFRACTORIES CORPORATION — America's Best Clays

WALSH REFRACTORIES CORPORATION

101 FERRY STREET • ST. LOUIS 7, MISSOURI

FOR OVER 60 YEARS MANUFACTURERS OF HIGH GRADE REFRACTORIES



PICTURE OF MAINTENANCE COSTS BEING LOWERED

Every plant that keeps complete records comes to the same conclusion—periodic valve lubrication *saves* money; it's valve failure and replacement that sends maintenance costs skyward.

That is the basic fact behind the Rockwell-Nordstrom valve design, for the internal lubrication system eliminates most reasons for valve failure—Rockwell-Nordstrom lubricant *prevents* galling, jamming, abrasive wear, and seepage.

Systematic lubrication of Rockwell-Nordstrom valves with the right Rockwell-Nordstrom lubricants inevitably leads to lower operating costs. There is no substitute for Rockwell experience—use it to save money on valves. *Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.*

THREE WAYS
THE NORDSTROM LUBRICANT WORKS

1. Lubricant surrounds each valve port with a vapor tight pressurized seal. **Nordstrom valves stay tight.**
2. Lubricant acts as hydraulic jack—a fast quarter-turn to open or close. **Nordstrom valves operate quickly.**
3. Lubricant coats the plug for sliding action—no wear-producing wedging. **Nordstrom valves operate easily.**

Rockwell Built

NORDSTROM VALVES

Lubricant-Sealed for Positive Shut Off

WHICH PRODUCT IS EASIEST TO MAKE?

Every manufacturing process has its own special problems. There's no fair way to compare the difficulties of processing paint and paper, or of synthetic rubber and synthetic textiles, for instance.

In every process industry, too, there are special problems of flow control, and no matter what claims you read, there is no such thing as an all-purpose valve.

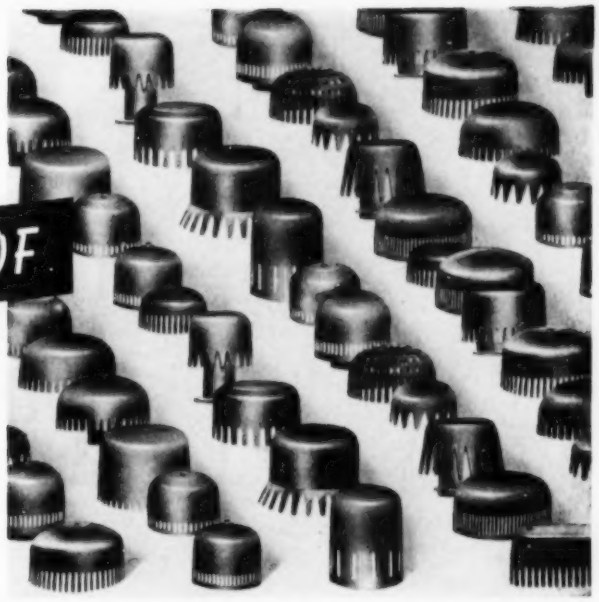
Undoubtedly, Rockwell-Nordstrom valves approach that point more closely than others because they use the Nordstrom-originated principle of internal lubrication. Rockwell-Nordstrom lubricants seal tightly in gas, liquid or slurry service, and at the same time make operation easy, and eliminate galling or seizing.

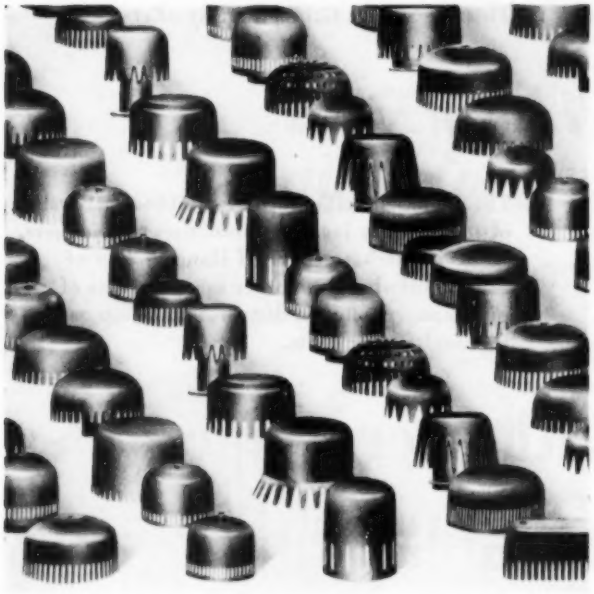
Further, Rockwell-Nordstrom makes the widest range of sizes, pressure classes, metals and lubricants, so that for any process, you're wise to check first with *Rockwell Manufacturing Company*, *Pittsburgh 8, Pennsylvania.*

Nordstrom Valves

Another Quality ROCKWELL Product

300 STANDARD STYLES OF PSC Bubble Caps & Risers





...promptly furnished *WITHOUT DIE COST*

With dies on hand for over 300 standard styles of bubble caps and risers, PSC is in a position not only to save many customers the cost of dies but also to save them design and delivery time. PSC bubble caps are also effecting substantial maintenance economies, due to the fact that PSC customers can order bubble caps in the particular metal which best meets their specific heat and corrosion requirements. We fabricate caps from any metal: aluminum, brass, copper, nickel, stainless steel in any chrome-nickel or straight chrome type, as well as carbon steel.

You'll Be Days and Dollars Ahead with PSC Caps

PSC catalog 52 contains, we believe, the largest compilation of engineering data on bubble caps; also drawings for use in determining methods of tray assembly. Details in catalog can be modified in almost unlimited ways to suit your needs. Special caps made to order.

—SEND FOR CATALOG 52—▷

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

☆ ☆ ☆ OFFICES IN PRINCIPAL CITIES ☆ ☆ ☆

For more data on advertised products, use Readers' Service Cards, last page.

Illustrated here are pictorial index pages from Grinnell's 92-page hanger catalog.

Grinnell has

pipe hangers and supports for every piping requirement, from simple water piping to high pressure, high temperature steam lines. No other company, anywhere, makes as complete a line of pipe hangers.

the **right** pipe hanger

If some detail of piping arrangement should make it necessary to deviate from hangers of standard design, it is important to remember that Grinnell will design and manufacture hangers to meet your special requirements. This is a service Grinnell freely offers.

to help you

Through Grinnell's efficient coast-to-coast system of strategically located warehouses and jobbers, you can purchase Grinnell Hangers "out of stock", anywhere. No other manufacturer of pipe hangers offers a distribution set-up as thorough or complete.

with every pipe hanging job!

Grinnell is ready to cooperate on all your pipe hanging assignments. For example, Grinnell will assist in the preparation of pipe suspension specifications. In addition, Grinnell, alone, of all manufacturers offers experienced field engineering service — maintains a staff of engineers who are ready to assist "on the job" with any problems in the erection of pipe hangers and supports.

GRINNELL

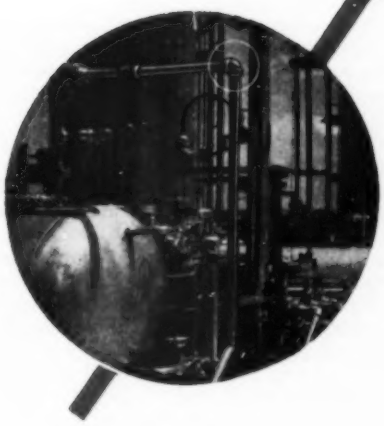
AMERICA'S No. 1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

CLOSE-UP VIEW of a HIGH SAFETY FACTOR

Against Costly Piping Failures



In power plants, chemical plants, refineries and other systems operating at high pressures and temperatures, W-S Forged Steel Fittings help protect the large investment in operating equipment. They provide a high safety factor against costly piping failures and plant down-time. They're drop-forged for *high strength* and *toughness*—the right combination of properties to withstand pressure, heat, shock, vibration and erosion. They're designed for extra strength, too—with extra heavy sections where you need them. And they're precision machined for perfect alignment.

Make Watson-Stillman Forged Steel Fittings your standard for safe, reliable operation of plant equipment. To suit any service and fabrication requirements, W-S Fittings are available in both Screw-End and Socket-Welding types in carbon, stainless and alloy steels. Write today for informative bulletins.

Sold Through Leading Distributors

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, New Jersey

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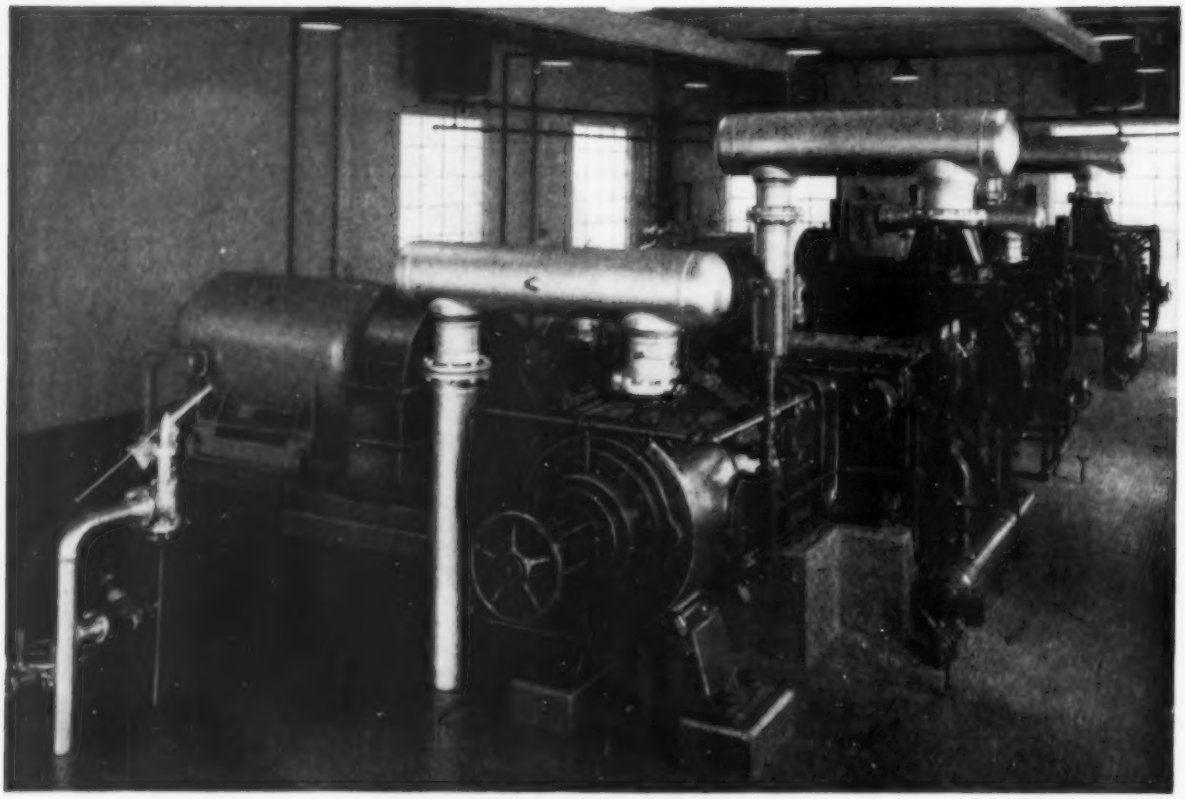
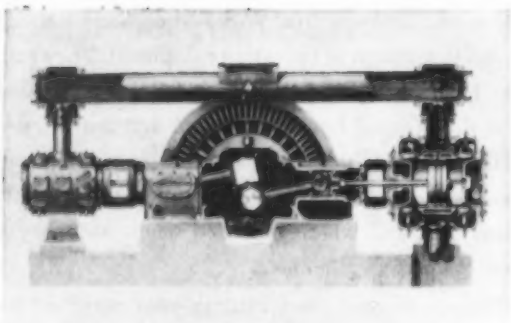


LINEUP OF WORTHINGTON 2-cylinder gas compressors at Frontier Oil's new Tonawanda (N.Y.) refinery. Units are rated at 600 hp each.

Frontier's new refinery gets Worthington compressors



CUTAWAY VIEW of Worthington balanced-opposed compressor. Note low silhouette, modest foundation requirements, and double-throw crankshaft which permits as many as four pairs of cylinders to be arranged on single compressor frame.

At Frontier Oil Refining Company's big new refinery in Tonawanda, N.Y., two Worthington type BDC-2 balanced-opposed gas compressors have gone to work in the two stage compression of hydro-carbon gas mixtures. By selecting Worthington units, Frontier made sure of:

Smooth, vibrationless operation. Two throw crankshaft with cranks set at 180 degrees gives opposed piston action.

Low-cost installation. Packaged design provides quick and easy field assembly. Lack of vibration permits location on small foundation.

In chemical plants and general industrial installations, these Worthington units are paying off in dependable operation. You can use practically any type of drive to power them. Like all Worthington compressors, they are equipped with the exclusive Feather* Valve — lightest, tightest, most efficient valve made.

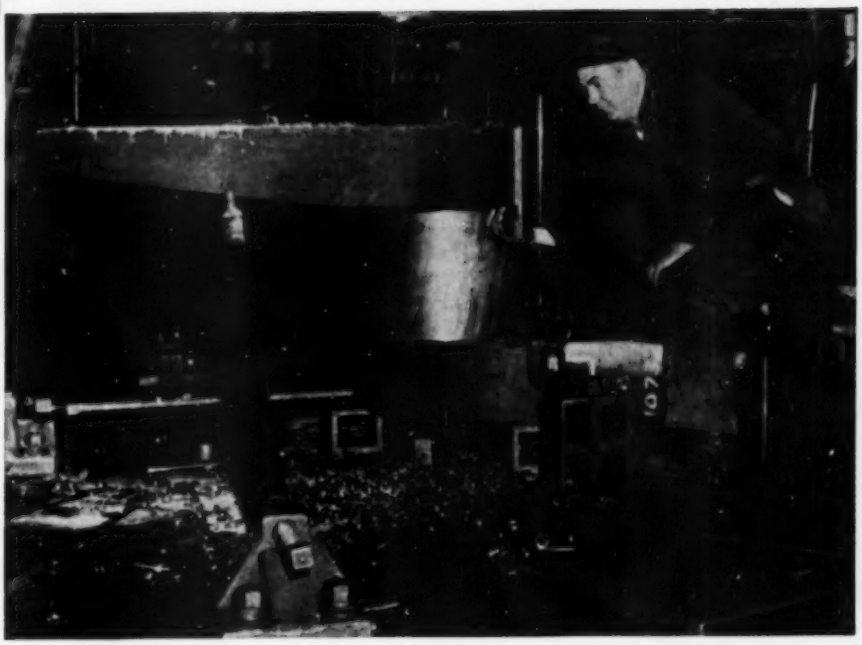
Remember, no matter what your capacity or pressure requirements may be, there's a compact Worthington steam- or motor-driven compressor to fill the bill. Write Worthington Corporation, Compressor Division, Section K.3.5, Buffalo, N.Y. K.3.5

** Reg. U.S. Pat. Off.*

WORTHINGTON

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Balanced-Opposed • Direct Connected • Gas Engine



The chips that talk...

To the native savage, whose tribe had no conception of a written language, the piece of wood on which the explorer scribbled a message became the wonderful "chip that talks."

The chips of metal that pour in silver drifts from the mighty machines in Sun Ship's Wetherill plant tell their stories, too. Those shown on the 14-foot boring mill tell part of the story of a fast, thorough repair job on ship-propulsion machinery. That job required lifting a 54-ton section of crankshaft from the ship to a 10 ft. x 50 ft. engine lathe, where it was checked for trueness and the journals machined. The crankpins were machined in a huge crankshaft machine. The boring mill operation shown was the facing of the webs of a new section which replaced one of the damaged sections of the crankshaft.

That's the kind of story the versatile men and machines at Sun Ship have been writing for decades . . . in building special machinery of every type for the varied industries that are building a greater America.

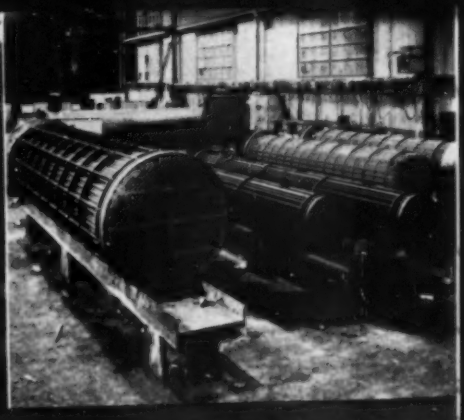
Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE (SINCE 1916) **CHESTER, PA.**

25 BROADWAY • NEW YORK CITY

For more data on advertised products, use Readers' Service Cards, last page.



HEAT EXCHANGERS

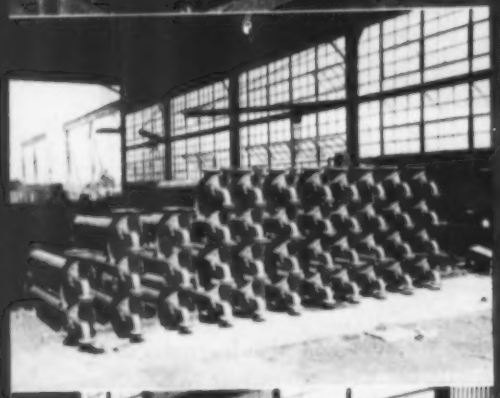
DESIGN · REPAIR FABRICATION

Performance engineered to fit YOUR heat transfer needs.

API-ASME and ASME Code Construction

MTF

Qualified for Construction in Ferrous and Non-Ferrous Materials



TEXAS METAL FABRICATING COMPANY

HOUSTON

MAIL ADDRESS: P. O. BOX 7567, HOUSTON 7, TEXAS

Your Inquiries Are Cordially Invited

Gulf Oil gives 7 reasons why **ALUMINUM PAINT** is used at its Port Arthur Refinery

Aluminum paint has been in continuous use since 1925 at Gulf Oil Corporation's Port Arthur, Texas, Refinery. A two-year field test at that time, and subsequent tests, prompted Gulf to adopt aluminum paint as a standard finish for many of its tanks, towers, buildings, process units and overhead piping installations. Here's what the tests have shown:

1. Aluminum paint has unusual qualities of *durability.*
2. The "leafing" quality of aluminum paint provides an excellent *moisture seal* against the high humidity and rainfall of the area.
3. Aluminum paint is *economical.* Some applications have had a life as long as 8 years.
4. It provides a good heat reflective surface for tank roofs . . . helps to reduce stock losses caused by evaporation.
5. Its slick, hard surface resists soot and dirt, provides good *long-term appearance.*
6. Aluminum paint is *easy to apply, with high spreading rate.*
7. It has *excellent one-coat hiding power.*

ALCOA does not make paint, but Alcoa Aluminum Pigments are used in more aluminum paints than any other brand. Special formulas have been developed by your paint manufacturer to solve individual problems. Paints made to these formulas actually cost you less, last longer, give utmost protection against heat, cold, sun, rain, smoke and fumes. Write us today for FREE BOOKLET, *Painting With Aluminum.*

ALCOA **ALUMINUM**

ALUMINUM COMPANY OF AMERICA

Paint Service Bureau, Aluminum Company of America
1793-J Alcoa Building, Pittsburgh 19, Pa.
Please send me your FREE BOOKLET, *Painting with Aluminum.* I plan to paint_____

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Lectrodryers
TRAP HARMFUL MOISTURE BEFORE IT REACHES AIR LINES

DRY air protects against freeze-ups and prevents harmful moisture from causing sludge or rust that may clog delicate instrument orifices. DRY air insures a clean, free flow to finely balanced controllers, valves and instruments . . . actually reducing maintenance problems.

Prevent harmful moisture condensation in air lines and obtain a flow of clean, DRY air by installing a Lectrodryer* and a Lectrofilter* at your air compressor. The filter frees the air of oil and grime after it leaves the compressor. The Lectrodryer continuously and automatically DRYs the air to dewpoints as low as − 100°F, depending on your need.

Investigate the new "BY" Lectrodryers. They're designed especially for instrument air service. They contain no moving parts, assuring minimum maintenance. And their DRYing adsorbent, Activated Aluminas, will not wear out.

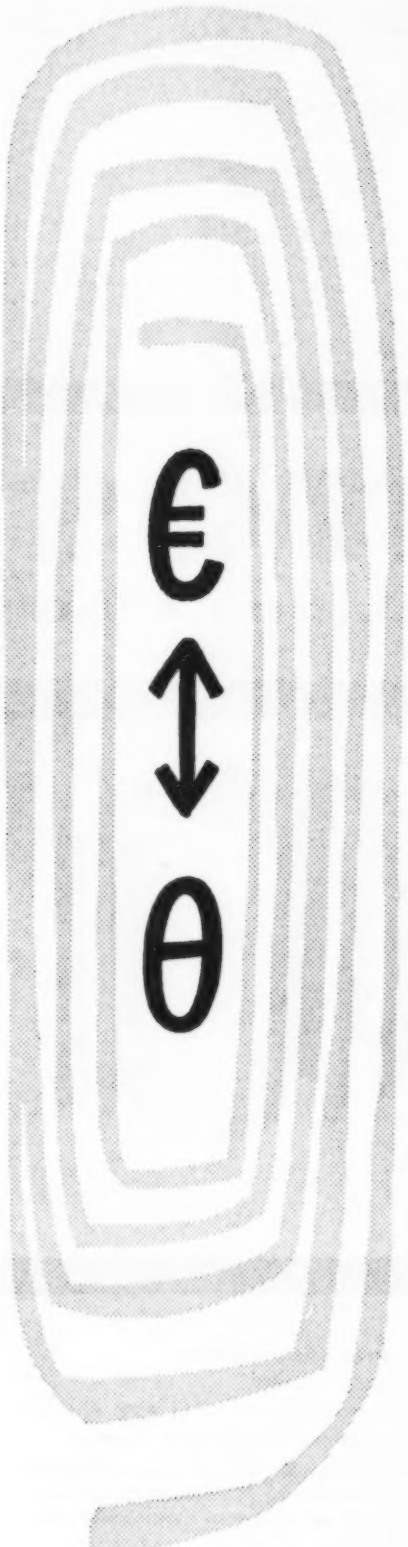
Write for the booklet *Because Moisture Isn't Pink.* It describes Lectrodryers and how industries are using them. We will welcome any inquiry you might have regarding DRYness engineering. Pittsburgh Lectrodryer Corporation, 307 32nd St., Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY
WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.



The above alchemical symbols represent limestone, coal, and salt, basic ingredients used in the lime-soda process to obtain caustic soda. These ancient symbols are portrayed in the entranceway to Wyandotte's new research center.

You can rely on Wyandotte

WYANDOTTE CHEMICALS

For a dependable supply of caustic soda

For over 64 years, Wyandotte has been a dependable producer of caustic soda.

In the petroleum industry, where caustic is used principally for removal of sulphur compounds and other objectionable impurities, Wyandotte has long been a steady supplier. Through periods of long and short supply, Wyandotte customers have benefited from a dependable and reliable source for caustic soda.

For safe, sure transportation of caustic

Wyandotte's fleet of caustic tank cars contains the MA-4 caustic-proof lining. This lining prevents iron pick-up in transit . . . assures purity on arrival!

The cars are insulated to prevent solidification of liquid caustic in any weather. Each shipment is analyzed during loading to be certain your specifications are met.

For help in caustic handling problems

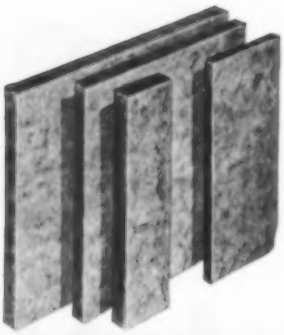
Wyandotte has had much experience in the economies of caustic handling. Skilled technical service men are available to help you. They'll work with you in the construction of caustic handling and storage systems. Contact Wyandotte today.

Wyandotte Chemicals Corporation, Wyandotte, Michigan
Offices in Principal Cities

Wyandotte CHEMICALS

HEADQUARTERS FOR ALKALIES

Soda Ash • Caustic Soda • Bicarbonate of Soda • Chlorine • Calcium Carbonate • Calcium Chloride • Glycols
Synthetic Detergents • Agricultural Insecticides • Soil Conditioners • Other Organic and Inorganic Chemicals



UNIBESTOS INSULATING BLOCK

for temperatures up to 1200° F.

For flat or large-radius curved surfaces... ideal for large vessels or storage tanks

UNIBESTOS insulating block is available in one standard length of 36"... four standard widths of 6", 12" 18", 36" ... thicknesses of 1" through 3" in ½" increments.

UNIBESTOS®

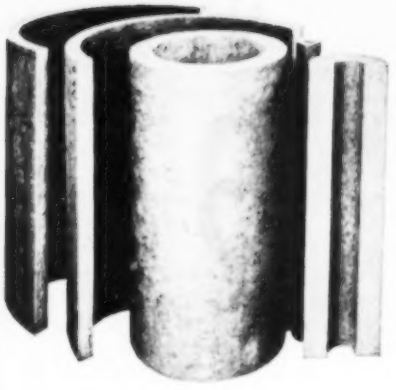
pipe insulation • insulating block

high thermal insulating efficiency plus maximum structural strength in temperatures up to 1200° F.

UNIBESTOS pipe insulation and insulating block guarantee high thermal insulating efficiency ... effectively withstand shock, heat, moisture, steam and acid fumes. Bonded Amosite Asbestos fiber provides maximum strength ... will not crack, crumble or powder, yet is easy to cut, saw or miter.

New single-layer application method with UNIBESTOS reduces working time considerably as compared to multiple-layer applications. A wide range of sizes and thicknesses makes application easy... saves time and labor. Positive heat-seals between sections eliminate caulking of joints.

UNIBESTOS can be removed and reapplied without damage. Where repeated access to bolting was necessary, records show reapplication of at least 25 times.



write for illustrated Brochure

UNARCO®

UNIBESTOS PIPE INSULATIONS

(half-rounds or cylinders)

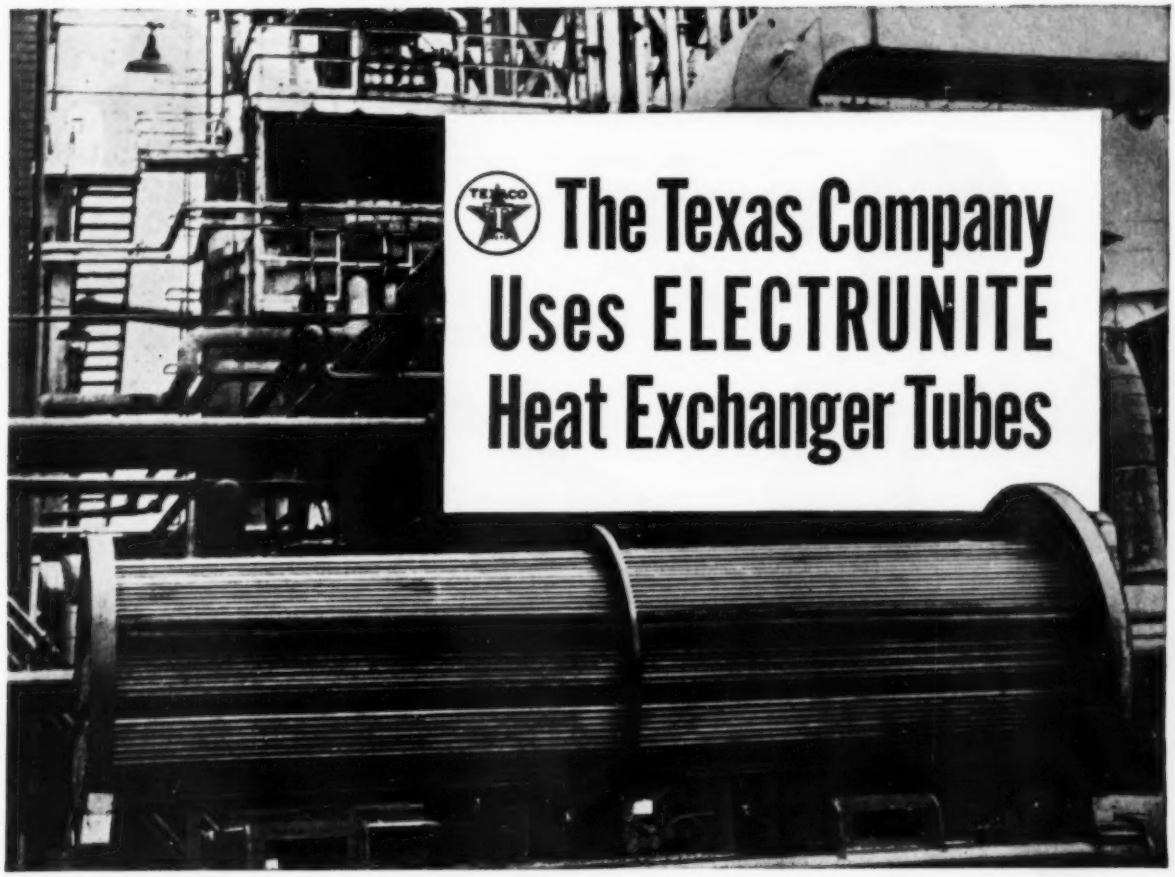
No. 750 for temperatures up to 750° F.

No. 1200 for temperatures up to 1200° F.

UNIBESTOS pipe insulation is made in 3-foot lengths as standard for pipes from ½" through 24" diameter, in thicknesses through 4". Special sizes available on a made-to-order basis.

UNION ASBESTOS & RUBBER COMPANY

332 South Michigan Ave. • Chicago 4, Illinois • Dept. PR-9



The Texas Company Uses ELECTRUNITE Heat Exchanger Tubes

The tubes in that bundle are on the job in the Lockport, Illinois, refinery of The Texas Company.

The Texas Company uses Republic ELECTRUNITE Heat Exchanger tubes. They stand up well under the severe service required in refinery operations.

Part of the reason is their quality. Republic controls this quality from ore to finished product. All along the way, there are checks for quality of the steel used, the manufacturing operations, right up to the final shipping. They are made in accordance with ASTM Specification A-214 or to customer's requirements.

Many of the country's largest refineries use dependable ELECTRUNITE Heat Exchanger Tubes. Some of them have been enjoying the advantages of these tubes for more than twenty-five years. Next time you buy heat exchangers, or you're re-tubing, call your Republic district sales office and get the complete story. Or write for a copy of the new booklet HEC-1.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
220 E. 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

REPUBLIC STEEL

Republic
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Other Republic Products include Carbon, Alloy and Stainless Steels — Bolts and Nuts, Steel and Plastic Pipe, Heat Exchanger Tubes

For more data on advertised products, use Readers' Service Cards, last page.

When a man makes his choice between two equally fine guns, he knows that, in the field or at the traps, there still will be . . .

. . . ENOUGH DIFFERENCE TO MAKE ALL THE DIFFERENCE

The same thing is true of many equipment purchases he makes for his business . . . heat exchanger tube being no exception. Many Scovill customers, for example, will tell you that Scovill's ultra-modern Continuous Casting process makes all the difference in the performance of our Phosphorized Admiralty Heat Exchanger Tube. The material is sounder . . . more uniform in chemical composition. Phosphorus content is uniform, optimum, most effective.

Scovill's outstanding Technical Application Services frequently give recommendations that make *all* the difference in the way a tough installation pays out. The potential savings are well worth looking into. Ask us to prove it. Scovill Manufacturing Company, 99 Mill Street, Waterbury 20, Connecticut. Phone Waterbury 4-1171.

SCOVILL
HEAT EXCHANGER TUBE

Phosphorized Admiralty ★ Admiralty ★ Arsenical Admiralty ★ Muntz Metal ★ Naval Brass ★ Red Brass, 85% ★ Deoxidized Copper Arsenical Copper ★ Copper Nickel, 10% & 20% ★ Cupro Nickel, 30% ★ Aluminum Brass ★ Aluminum Bronze, 5% ★ Duplex Tube

78C84

525 Wm. Penn Place Building, Pittsburgh, Pa.

PROTECTING
PIPING SYSTEMS IN THE
WORLD'S FINEST BUILDINGS

Williams-Hager

FLANGED

Silent

CHECK VALVES

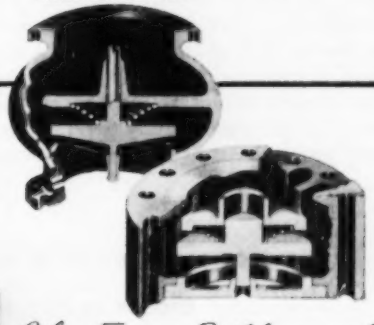
Piping systems of some of the world's most famous buildings are "safe and silent"—free from the damaging vibration and noise caused by *water hammer*—due to the installation of Williams-Hager Check Valves. This is a high tribute, you will agree, to their superior quality and dependability. A tribute, which we believe makes them worthy of your consideration when specifying check valves for assured protection of your piping systems.

Write for Bulletin 654

THE WILLIAMS GAUGE CO., INC.

1640 PENNSYLVANIA AVE. PITTSBURGH 33, PA.

Established 1886



Other Famous Buildings and Hotels

IN WHICH WILLIAMS-HAGER VALVES HAVE BEEN INSTALLED

Pentagon Building, Washington, D.C.
Hotel Statler, Los Angeles, Calif.
Merchandise Mart, Chicago, Ill.
Hotel Conrad Hilton, Chicago, Ill.
Empire State Building, New York, N.Y.
Hotel Waldorf Astoria, New York, N.Y.
Alcoa Building, Pittsburgh, Pa.
Hotel Drake, Chicago, Ill.
Rockefeller Center Buildings, New York, N.Y.
Fidelity Philadelphia Trust Building, Philadelphia, Pa.
Hotel Astor, New York, N.Y.
Metropolitan Life Insurance Building, New York, N.Y.
Hotel Sherry Netherlands, New York, N.Y.
Prudential Life Insurance Building, Newark, N.J.
Chicago Tribune Building, Chicago, Ill.
Federal Reserve Bank Building, Chicago, Ill.
New England Mutual Life Insurance Building, Boston, Mass.
Standard Oil Building, Chicago, Ill.
U.S. Steel Corp. Building, New York, N.Y.
Daily News Building, Chicago, Ill.

For more data on advertised products, use Readers' Service Cards, last page.

WHEN OXIDATION IS A PRIME FACTOR

Tube Selection Cannot be Reduced to a Formula

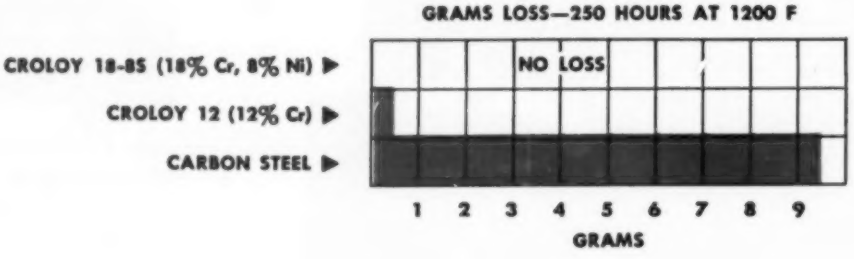
—even a complicated one

When any metal is exposed to high temperatures, it burns. Slow burning is called oxidation and in the process scale forms on the metal being burned. If the process continues the scale will flake off, causing loss of metal.

One of the major benefits resulting from alloying chromium with iron is greatly increased resistance to oxidation at high temperatures. A tight surface layer of chromium-rich oxide is formed and this layer retards oxygen diffusion. Tests have shown that resistance of chromium alloy steel to oxidation is directly proportional to the chromium content of the alloy. The chart below compares relative oxidation resistance at 1200 F of stainless and carbon steels, as determined by scale loss on heating 250 hours.

But only an expert can properly evaluate all of the elements that make up the best analysis to match the requirements of your specific tubing application. There is no substitute for the kind of experience with these problems you'll find at B&W.

To get the most benefit from B&W's long experience in matching tubes to jobs, call on Mr. Tubes, your nearby B&W Tube Representative. He can help you make the best choice.



THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-4060(P)

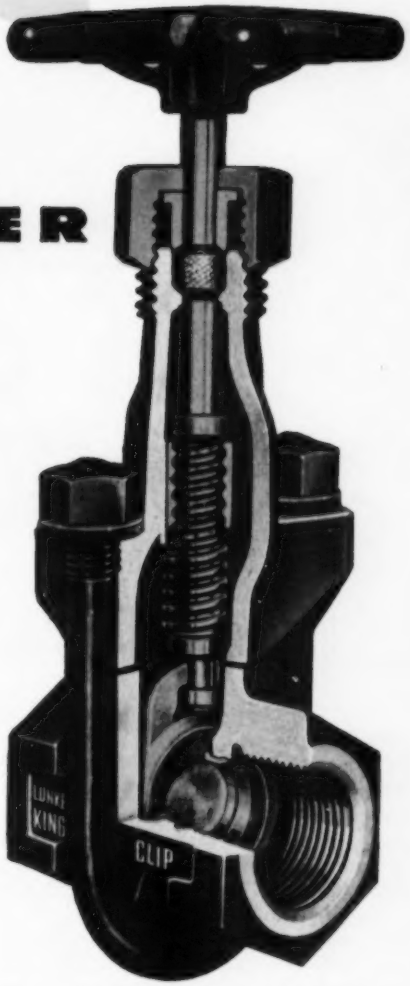
For more data on advertised products, use Readers' Service Cards, last page.

Tightest gate valve . . . . . you ever used!

the original clip valve with the NEW **non-slip®** *handwheel**

King-clip®

by **LUNKENHEIMER**



It closes tight . . . it stays tight . . . and here are four good reasons why:

The new Non-Slip Handwheel provides a firmer, more comfortable grip for closing—even when the operator's hands are wet or greasy.

The body provides unusual ruggedness—protects the valve against distortion from wrenching or pipe stresses . . . and the steel clip permits quick disassembly and reassembly.

Extra thread length prevents pipe ends from jamming against diaphragm or seat rings to force them out of line. Threads accommodate both A. P. I. and standard threaded pipe.

Stemalloy* stems, in the Iron Body Bronze Mounted patterns, have amazing resistance to thread wear. Millions are in use, and *not one* has ever been returned due to wear failure.

LUNKENHEIMER
QUALITY

BRONZE · IRON · STEEL

Ask your Lunkenheimer Distributor about "King-clip" — the original Lunkenheimer clip valve with cast-in drain channels and a bonnet-thread bushing for perfect stem alignment. For full details, request Circular 561 from your distributor or The Lunkenheimer Company, Box 360G Cincinnati 14, Ohio.

*Patented

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

For more data on advertised products, use Readers' Service Cards, last page.

Welded-In Tubes in High Pressure Service... 7 years without a failure

One of the greatest problems in operating high pressure feedwater heaters in modern super-pressure power plants is failure of expanded tube joints. In 1947, Lummus pioneered the field in *welding* monel tubes to steel tube sheets in feedwater heaters. Two such units were built for the city of Lansing, Michigan, designed for 1200 psi. These units have had no failures in seven years of operation.

Lummus now has developed a procedure of welding copper nickel tubes to steel tube sheets. Subjected to terrific pressure and temperature tests, the welded units have gone through many cycles with excellent results. Lummus has also made one installation, in service now for over six months without a failure, having a design pressure of 2900 psi, and requiring over 30,000 70-30 cupro nickel tubes welded into steel tube sheets.

The unit shown above, with a design pressure of 2,600 psi, is being fitted with 70-30 cupro nickel tubes. Successful installations have also been made with 80-20 cupro nickel tubes.

Welding-in of tubes eliminates the possibility of tube joint failure because of fabricating inaccuracies, tube irregularities, nickel oxide deposits from annealing operations, and excessive tube hardness. Welding-in makes possible the use of heavy wall tubes which cannot be satisfactorily expanded.

Your inquiries are invited.

THE LUMMUS COMPANY, Heat Exchanger Division: 385 Madison Avenue, New York 17, N. Y.
Atlanta • Boston • Chicago • Rock Island • Cincinnati
Detroit • Houston • Tucson • Tulsa • Salt Lake City
Minneapolis • Pittsburgh • Rochester • Albany
St. Louis • San Francisco • Wayne (Phila.) • Athens
Buenos Aires • Honolulu • London • Manila • Toronto
Paris • Rome • Lima • San Juan, P. R. • Mexico City
Fabricated Piping Division Plant at East Chicago, Ind.

Steam Surface Condensers • Evaporators • Extraction Bleeder Heaters • Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers for Process and Industrial Use • Process Condensers • Pipe Line Coolers.

LUMMUS

THE LUMMUS COMPANY HEAT EXCHANGER DIVISION, 385 MADISON AVE., NEW YORK 17, N. Y.

Sulfuric acid goes hungry here

Takes a pretty tough alloy to keep sulfuric acid on a starvation diet.

Yet these 8" gate valves of corrosion-resistant *Aloyco 20* do just that. They control the acid flow to four large absorbing towers in U.S. Industrial Chemicals' new 300-ton acid plant. Built by Leonard Construction Company at Tuscola, Illinois, it supplies acid for National Petro-Chemicals Corporation and the general market. *Aloyco 20* valves are standard throughout the plant for handling sulfuric acid.

Here, as in scores of industrial processing plants, Aloyco Valves speed the flow of chemical progress. **Alloy Steel Products Co., Inc., 1301 West Elizabeth Avenue, Linden, New Jersey.** 44

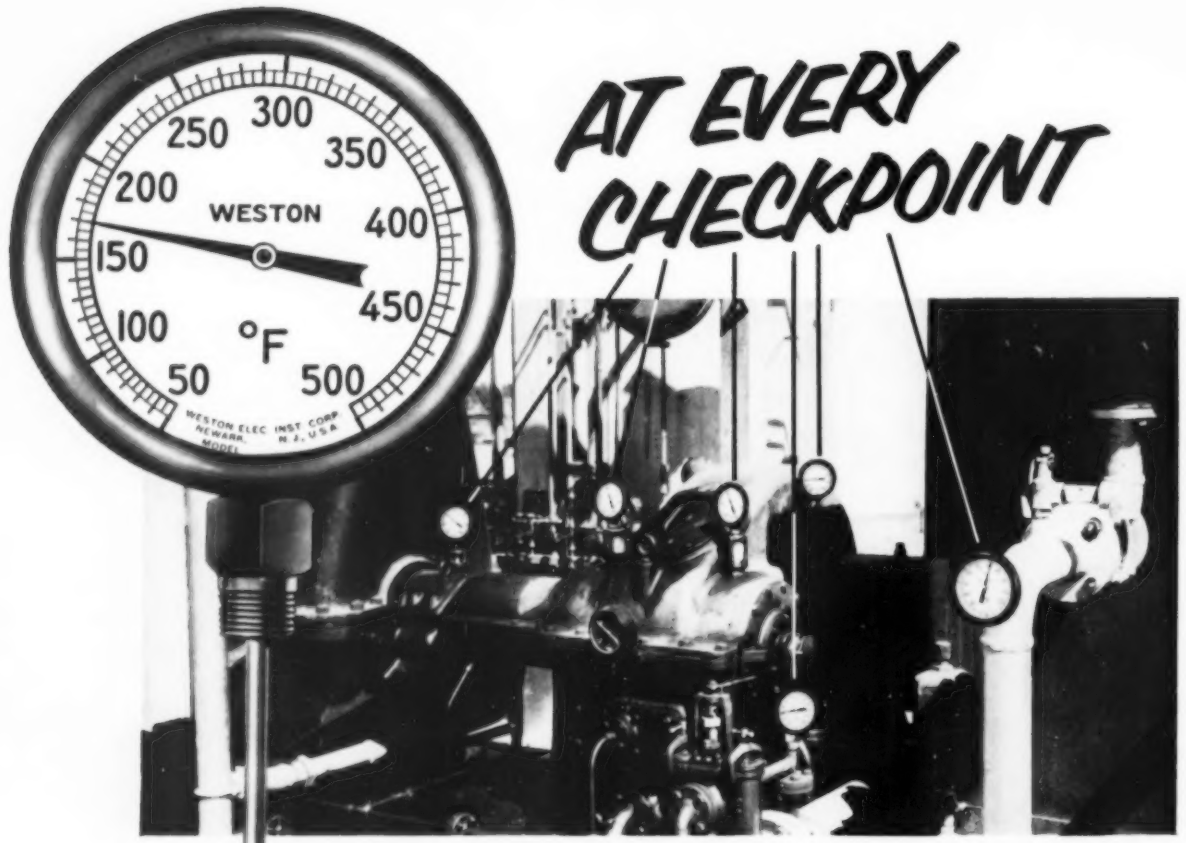
25TH ANNIVERSARY

Longer Lasting

ALOYCO

VALVES

FIRST IN CORROSIVE SERVICE

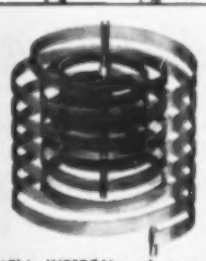


WESTON *all-metal* THERMOMETERS

(with Multiple Helix)*

Here's another typical example of how large processing plants have solved temperature checking problems, and cut thermometer costs besides. With a WESTON dial-type thermometer at every checkpoint, temperatures are read at a glance . . . in far less time, and with far greater accuracy. Their sturdy all-metal construction resists breakage, gives them far longer life on operating equipment. And the exclusive WESTON multiple helix employed assures dependable accuracy during all this long life.

Available in a broad selection of types, sizes, ranges and stem lengths, WESTON thermometers are today standard on all types of mobile and stationary equipment and machines, large and small; as well as on piping, conduit, ducts, etc. Ask your distributor, or local WESTON representative for complete information, or write for descriptive bulletin . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.



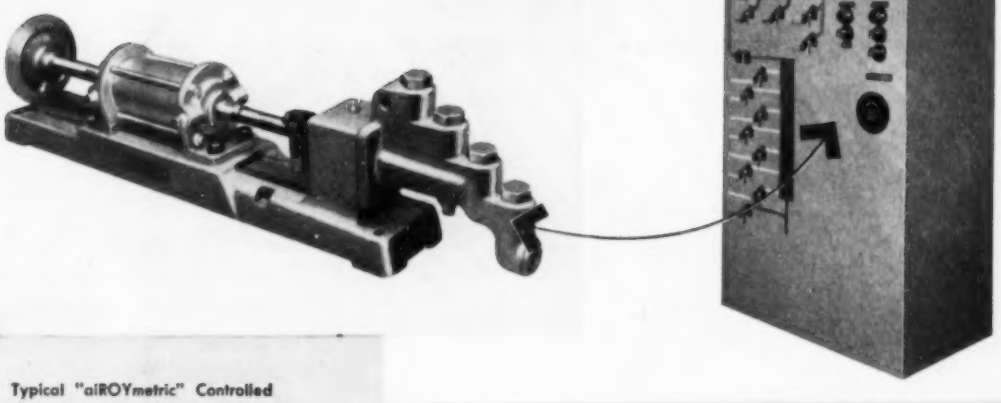
***This WESTON-made sensing element is the more costly, non-sagging, multiple-helix. Carefully aged over a broad temperature range for long periods, it assures better accuracy, over a longer life.**

WESTON 5537
Thermometers

Stocked by leading Distributors

CONTROLLED VOLUME PUMPS ARE FLOW-CONTROL INSTRUMENTS

This Milton Roy graphic panel provides centralized control and monitoring of 23 air-powered Controlled Volume Pumps to regulate a continuous polymerization process.



Typical "aiROYmetric" Controlled Volume Pump. Air-powered pumps have a capacity range of from .04 to 405 gallons per hour against pressures up to 25,000 pounds per square inch. Capacity can be varied manually or automatically.

MILTON ROY GRAPHIC PANEL CONTROLS CONTINUOUS PROCESS

Flow controllers, ratio controllers and final control elements . . . these are the functions performed by 23 Controlled Volume Pumps in automatically controlling a continuous process.

This graphic panel—installed after full study and pilot plant testing—provides centralized control and monitoring of all 23 Controlled Volume Pumps used in the process. Some of these pumps control the flows and maintain the ratios of process streams. Others are used as final control elements, controlling the flow of catalyst in response to process demand, as dictated by the reactor temperature controller.

Milton Roy Controlled Volume Pumps are flow-control instruments that can *solve your flow-control problems.* Our Engineering Services include detailed recommendations on pumps, process instrumentation, accessories, panel design and construction.

Reference Literature: Write for Application Engineering Data Sheet A-54-2 "Instrumentation of a Continuous Reactor" and Bulletin 1053 "Air-Powered Controlled Volume Pumps."

See the MILTON ROY EXHIBIT
BOOTHS 131-136
First International Instrument Congress and Exposition
PHILADELPHIA—SEPTEMBER 13-24, 1954

MILTON Roy COMPANY

Engineering representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

Manufacturing Engineers 1315 E. MERMAID LANE • PHILA. 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

For more data on advertised products, use Readers' Service Cards, last page.

ON THE JOB
DAY AND NIGHT—
Low-Cost, Purchased

Electric Power

Purchased Electric Power is the Petroleum Industry's biggest bargain; its cleanest and most efficient servant (notice spotless control room). In every phase of production — from well to refinery — PEP* proves its superiority, dependability and its economy.

*Purchased Electric Power

PRODUCE MORE IN '54 WITH PURCHASED ELECTRIC POWER!

CALL YOUR NEAREST ELECTRIC SERVICE COMPANY for more facts, or address your request to P. O. Box 2771, Dallas, Texas

Petroleum Electric Power association

ORGANIZED in the interest of greater service to the petroleum industry

Equipment with Engineering Service

Send for Bulletin No. 405

MECO

MAINTENANCE Engineering CORPORATION

P. O. BOX 2637

3711 CLINTON DRIVE
HOUSTON, TEXAS

WRITE OR PHONE US YOUR PROBLEM

For more data on advertised products, use Readers' Service Cards, last page.

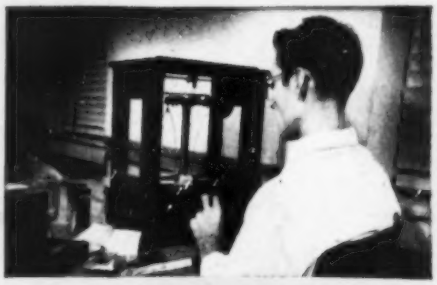
INJECT *Visco*® AHEAD OF TROUBLE

Injection of Visco Anti-Corrosion Chemicals ahead of trouble spots in refinery lines and equipment is a sound, low-cost prescription for effective corrosion control. This is the way Visco Anti-Corrosion Chemicals work: They form a tough, monomolecular film on metal surfaces by adsorption to the metal. The film is highly resistant to corrosive gases and liquids encountered in refining, and is maintained by small dosages at intervals, or in proportion to throughput rates. Other important characteristics include high temperature stability, no emulsion-forming tendencies, and no catalyst poisoning or color effects on finished products.

Detailed data on Visco Anti-Corrosion Chemicals for your applications will be sent promptly upon request. Write today.

VISCO PRODUCTS COMPANY
INCORPORATED
2600 Nottingham at Kirby
Houston 5, Texas • Telephone MAdison 0433

Sure Sign of EFFICIENT Corrosion Protection



Proof of Corrosion Control

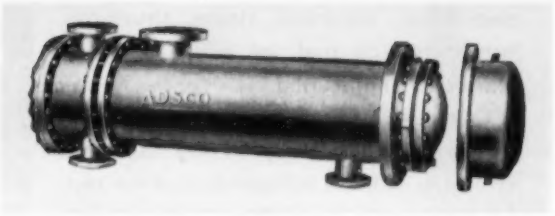
One method of obtaining data on corrosion rates consists of accurately weighing small metal coupons before and after placement in process lines. Your Visco Representative can help you select a means of proving the effectiveness of Visco corrosion control in your equipment . . . with no obligation to you. Write or phone for action now.

Visco **CONSISTENTLY EFFICIENT OIL INDUSTRY CHEMICALS**

ADSCO ENGINEERED

TO SOLVE ANY HEAT-EXCHANGER PROBLEM

Standard-design or tailor-made, ADSCO heat exchangers are engineered and manufactured to fit the exacting needs of ADSCO's industrial customers. Upon receiving a set of thermal conditions from a customer, ADSCO first applies its many years of experience to the design of the exchanger. And then into the manufacture goes all the know-how which ADSCO has acquired during its 75 years. The result is an exchanger which is not "almost right" but exactly right, a unit of the utmost efficiency... Investigate this specialized ADSCO service. You'll find it is low-cost, yet everywhere carries the ADSCO mark of quality which since 1877 has made ADSCO a leader.



A type of ADSCO heat exchanger widely used in industrial plants is the float-head, split-ring heat exchanger shown above. It is used for heating, cooling, or condensing, or for a combination of these. Shells can be of steel or a non-ferrous metal with either steel or non-ferrous tube sheets. Tubes of the removable tube bundle vary in size from 5/8" O. D. to 1¼" O. D. The pitch can be square or rectangular, depending on the fouling conditions and cleaning requirements. ADSCO heat exchangers are manufactured in conformity with ASME code for unfired pressure vessels.

ADSCO
ENGINEERED PRODUCTS
SINCE 1877

Expansion Joints . . . Separators . . . Meters . . . Steam Traps . . . Heat Exchangers . . . Strainers

AMERICAN DISTRICT STEAM COMPANY, INC.

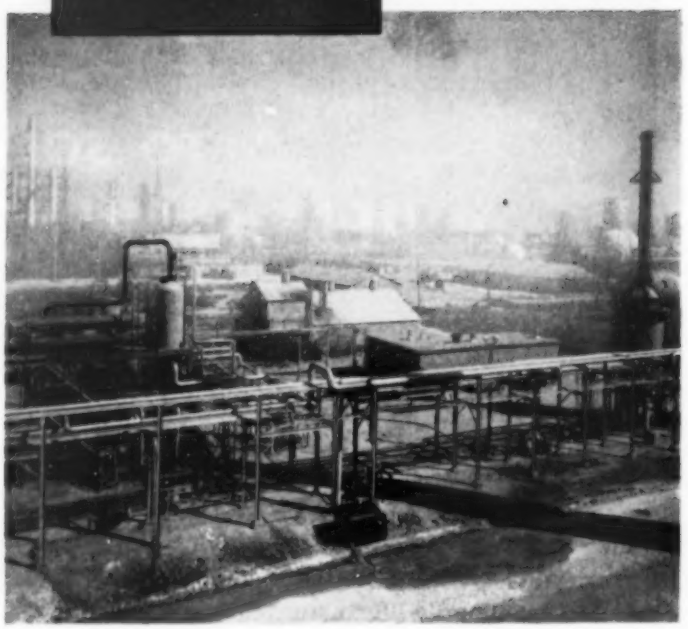
GENERAL OFFICES
NORTH TONAWANDA, NEW YORK

PLANTS
NORTH TONAWANDA, N. Y. — RICHMOND, CALIF.

For more data on advertised products, use Readers' Service Cards, last page.

End-Products OF

Petrochemical plant recently completed for a major oil company and now in operation.



● Complete plants or units designed with full understanding of the processes involved . . . utilizing a wealth of past experience, complemented by the most up-to-date techniques and selection of equipment.

Our design staff consists of process engineers thoroughly experienced in all phases of petroleum refining, petrochemical developments and many organic and inorganic processes. These key men are complemented by engineers specializing in mechanical, electrical, steam, structural, instrumentation and the other corollary phases of engineering.

Our complete services are listed below. However, unlike many in the field, we offer any of these independent of the rest. In other words, our service is as complete as the client wishes.

STEP BY STEP TO COMPLETION

PROCESS EVALUATION

Technical and economical evaluations in cooperation with client's staff.

PROCESS ENGINEERING

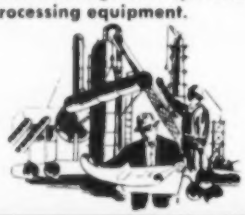
Detailed development of flowsheet with sizings and ratings of major and auxiliary processing equipment.

PROJECT ENGINEERING

Complete mechanical design, including details of all auxiliary services.

PROCUREMENT

Purchasing, expediting and delivery scheduling of all materials and equipment.



CONSTRUCTION

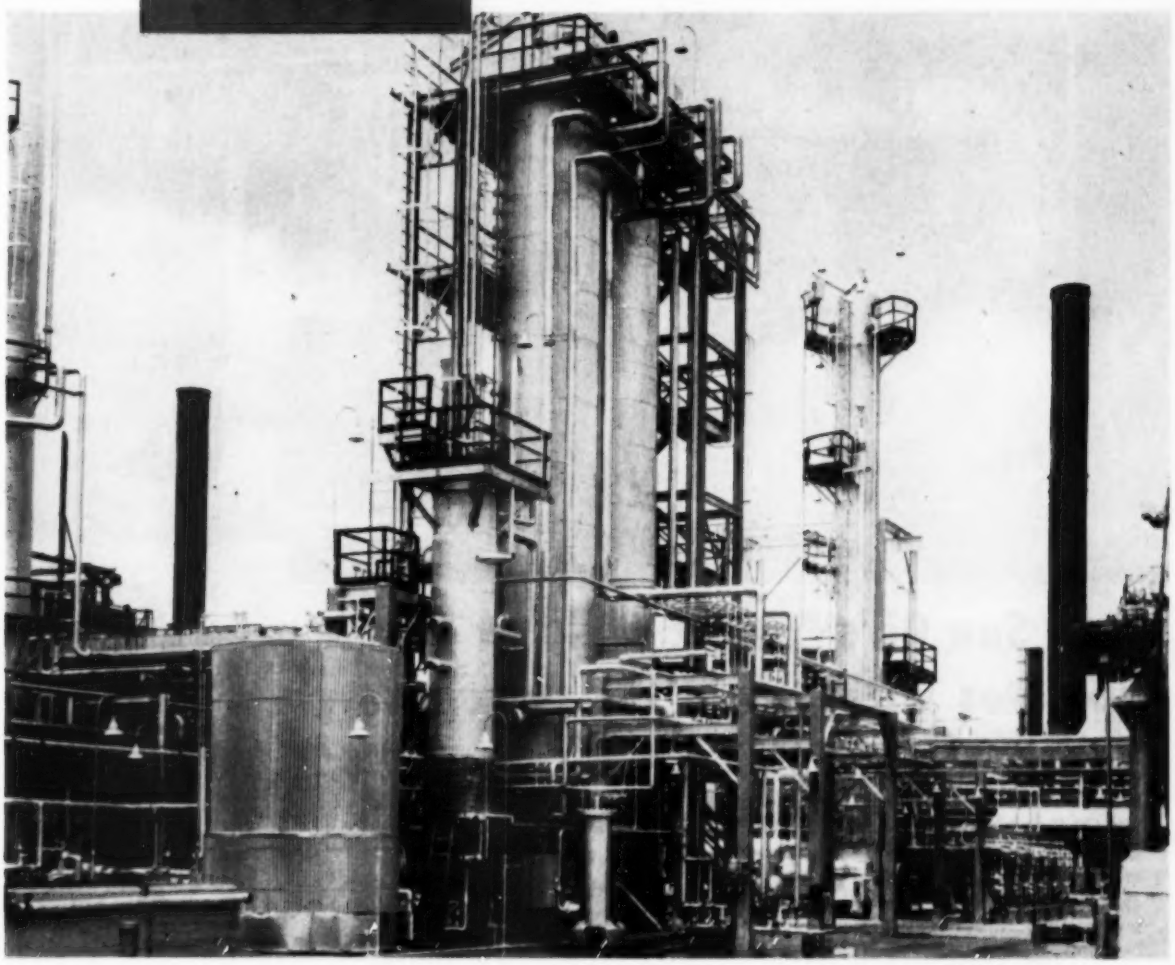
Complete field erection of the project.

INITIAL OPERATION

Assisting in start-up operations; working with owner's staff in an advisory capacity.

EXPERIENCED ENGINEERING

Catalytic polymerization unit recently completed for Socony-Vacuum Oil Company, Inc.



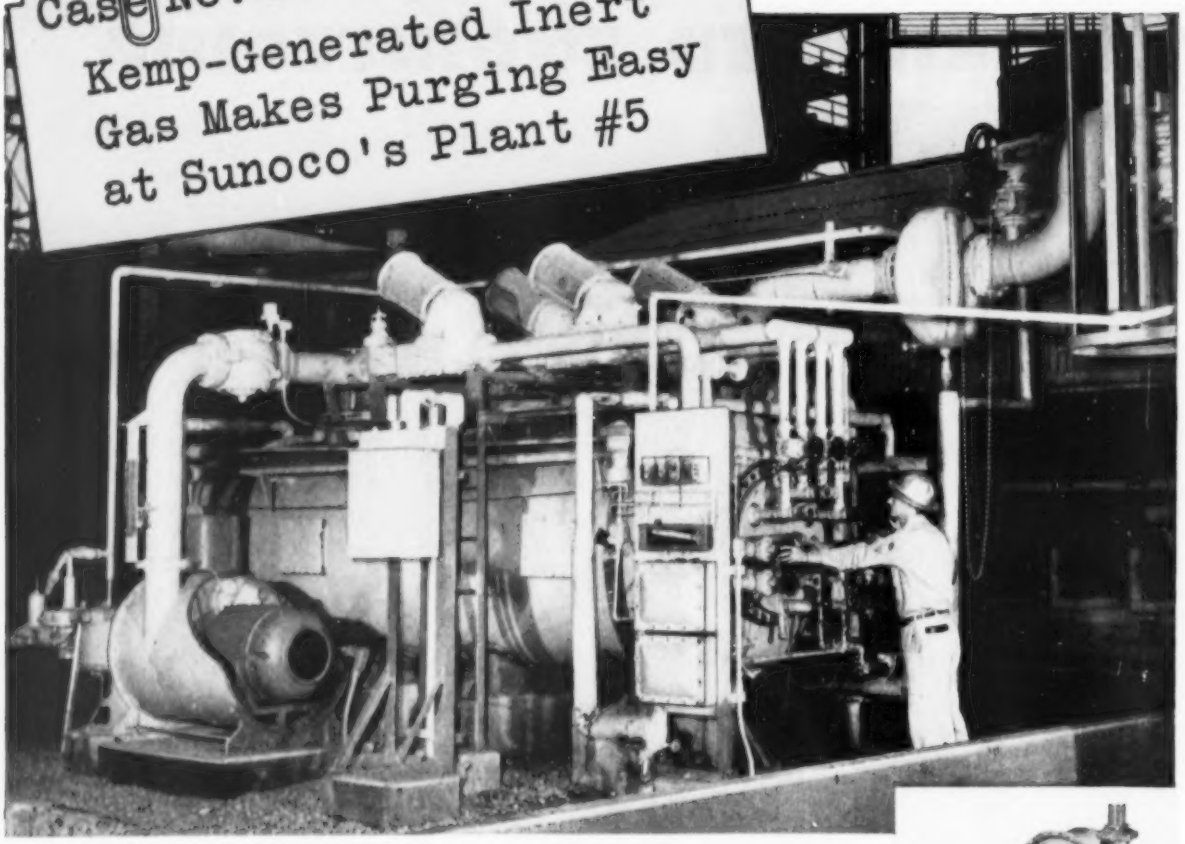
Other projects, already completed and in operation or under construction, include plants and units for the Recovery of Aromatics from Petroleum Stock •Separation of Para Xylene • Synthetic Methanol Refining • Naphthalene Purification • Recovery of Acetic Acid • Recovery of Ammonia • Catalytic Polymerization • Gasoline Treating • Ethyl Alcohol Refining

BADGER MANUFACTURING COMPANY

230 BENT STREET, CAMBRIDGE 41, MASS. • 60 EAST 42nd STREET, NEW YORK 17, N. Y.

For more data on advertised products, use Readers' Service Cards, last page.

Case No. 57
Kemp-Generated Inert Gas Makes Purging Easy at Sunoco's Plant #5



How Sun Oil's "Magic Mill" at Toledo operates with 'round the clock safety

There's no *one* word that strikes terror in the hearts of oilmen everywhere more quickly than F-I-R-E! To combat this threat at the Sun Oil Co.'s giant refinery at Toledo, Ohio, constant vigilance, checks and inspections are the answer. And the liberal use of inert gas for purging pipelines, tanks and crackers is essential to this safety maintenance.

Kemp selected to do the job

When plans called for *doubling* plant production in 1950, a new Kemp Generator (see above) was installed to insure adequate inert gas production. Fast-starting, easy-to-operate, this Kemp unit more than filled the bill. Today tanks and lines are periodically purged for inspection and cleaning *as often as needed*. And thanks to its 60,000 cu. ft. per hr. Kemp Inert Gas Generator, Sunoco enjoys *exact analysis* inert production that meets all its purging requirements.

Let Kemp help you, too

If you have a purging or blanketing problem, why not let Kemp Engineers give you the same helpful advice used so profitably at Sun Oil's Toledo refinery. It costs you nothing to investigate. And it may save you money. Find out how Kemp's wide range of dependable, low-cost Generators (complete with the latest fire checks and safety devices) offer you the best way to solve your problems.

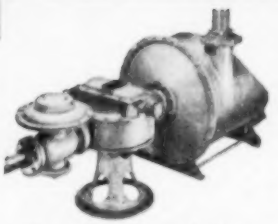
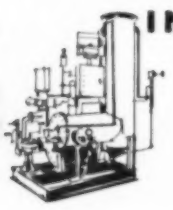


Photo above shows close-up view of Kemp Industrial Carburetor, the heart of every Kemp installation. Assures complete combustion... without waste, without tinkering. Reduces installation costs, simplifies maintenance.

***For more complete facts and technical information, write for Bulletin I-10 to:* C. M. KEMP MFG. CO., 405 E. Oliver Street, Baltimore 2, Maryland.**

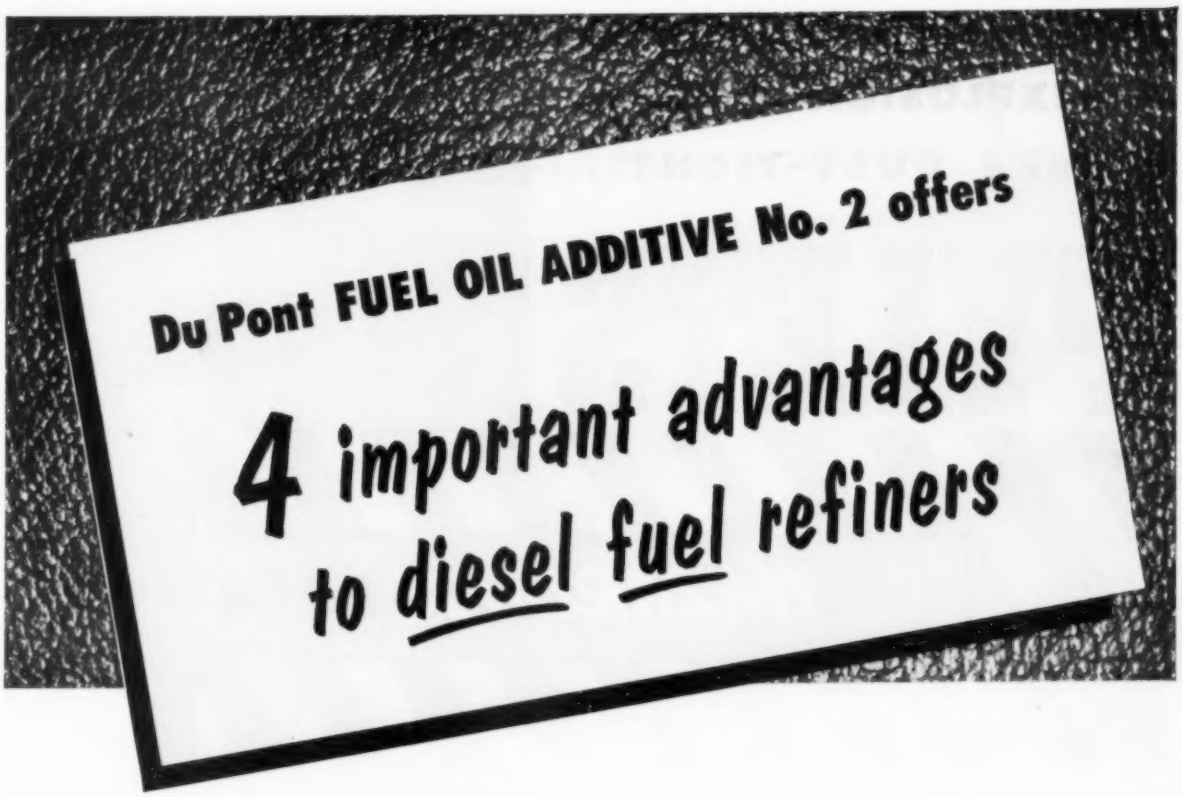
KEMP OF BALTIMORE



INERT GAS GENERATORS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • ADSORPTIVE DRYERS • SINGEING EQUIPMENT

For more data on advertised products, use Readers' Service Cards, last page.



1. Leaves no deposits

Being ashless, Du Pont Fuel Oil Additive No. 2 leaves no combustion chamber deposits to cause operating difficulties.

2. Gives added flexibility

To help you gain added flexibility and capacity in diesel fuel production, Fuel Oil Additive No. 2 enables you to blend cat-cracked and straight-run stocks, without sacrificing stability in the blend.

3. Upgrades heavy oils

This additive can help you upgrade your heavy distillate fuel oils because it allows a certain amount of these heavy oils to be blended in the diesel fuel without affecting filterability.

4. Prevents clogging

Du Pont Fuel Oil Additive No. 2 not only retards the formation of insoluble residues, but also reduces the particle size of those insoluble residues that are formed and thus reduces clogging of diesel filter screens. Highly concentrated, Fuel Oil Additive No. 2 will produce desired results at the lowest possible cost.

Storage tests show that in all cases this additive—originally developed as a stabilizer and dispersant for distillate heating oils—gives best results when added at the refinery to freshly prepared stocks.

Free samples and more detailed information on Fuel Oil Additive No. 2 are available from any Du Pont Petroleum Chemicals Division representative or regional office.

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

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HOUSTON, TEXAS—705 Bank of Commerce Bldg. . . . . Phone PReston 2857
LOS ANGELES, CALIF.—612 So. Flower St. . . . . Phone MAdison 1691

IN CANADA: Canadian Industries Limited—Toronto, Ont.—Montreal, Que.—Calgary, Alta.
OTHER COUNTRIES: Petroleum Chemicals Export—Nemours Bldg., 6539—Wilmington 98, Del.

For more data on advertised products, use Readers' Service Cards, last page.

EXPLOSION-PROOF and DUST-TIGHT

PYLETS®

FOR HAZARDOUS LOCATIONS

For added safety in hazardous locations specify from this rapidly expanding quality line of explosion-proof and dust-tight Pylets which the Pyle-National Company is constantly developing to meet the growing needs of industry.

All explosion-proof and dust-tight Pylets are designed in accordance with Underwriters' Laboratories requirements for electrical devices used in hazardous locations as defined in Article 500 of the National Electrical Code.

The substantial construction and high quality of materials and workmanship insures added safety, uninterrupted service and long life.

Consult your Pylet Catalog 1100 for complete listings of Explosion-Proof and Dust-Tight Pylets sold through electrical distributors.

SINCE 1897

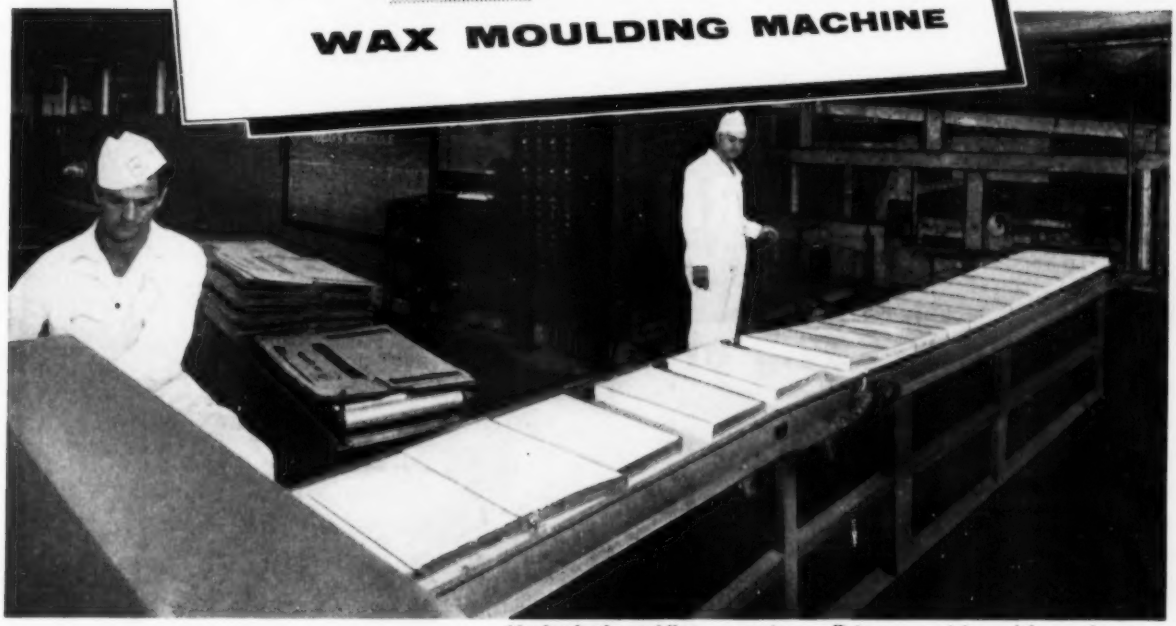
THE PYLE-NATIONAL COMPANY

1393 NORTH KOSTNER AVENUE, CHICAGO 51, ILLINOIS

District Offices and Representatives in Principal Cities of the United States
Export Department: International Railways Supply Co., 30 Church St., New York
Canadian Agent: The Holden Co., Ltd., Montreal

PLUGS AND RECEPTACLES • FLOODLIGHTS • TURBO-GENERATORS • GYRA[illegible]

THE GREER CONTINUOUS WAX MOULDING MACHINE



Mechanized moulding — maximum efficiency — minimum labor and space.

What is it costing you to be without one?

Labor **A Greer Wax Moulder** increases pounds of wax slabbed per manhour 3½ to 5 times over conventional batch processes. It automatically deposits, cools, and demoulds up to 15,000 pounds per hour of 10-lb. cakes.

Floor Space . . . more valuable than ever, and **a Greer Wax Moulder** uses only approximately 1/10th that occupied by usual batch processes of equal capacity.

Product Uniformity and Appearance

Cakes are held within ½ of 1% in weight for a given setting by the volumetric depositor in **a Greer Wax Moulding Machine.** You'll get improved appearance and cleanliness of cakes, too.

Compare these profit-building advantages with your present wax-slabbing process, then get all the facts on the **Greer Wax Moulding Machine.** *There is no obligation*

J. W. GREER COMPANY

WILMINGTON, MASSACHUSETTS

Sales Engineering Offices: New York, N.Y., Chicago, Ill., San Francisco, Calif.

GREER

For more data on advertised products, use Readers' Service Cards, last page.

An unbeatable team for temperature measurement

DYNALOG RECORDERS and DYNATHERM BULBS

You can't beat this Foxboro Dynalog-Dynatherm combination for insuring better temperature measurement on any job between −100° and +600°F. It gives you every advantage of speed, accuracy, long leads, simple installation, economy, and freedom from maintenance. This is why:

The Dynalog Electronic Recorder has an exclusive variable-capacitor measuring system which eliminates slidewires, gears, cables, high speed balancing motors . . . no dead space, no batteries to standardize, no motors to service. Standard full-scale pen speed only 3 seconds. Sustained accuracy ¼ of 1% guaranteed. Available for spans as narrow as 5°F. with full-accuracy calibration.

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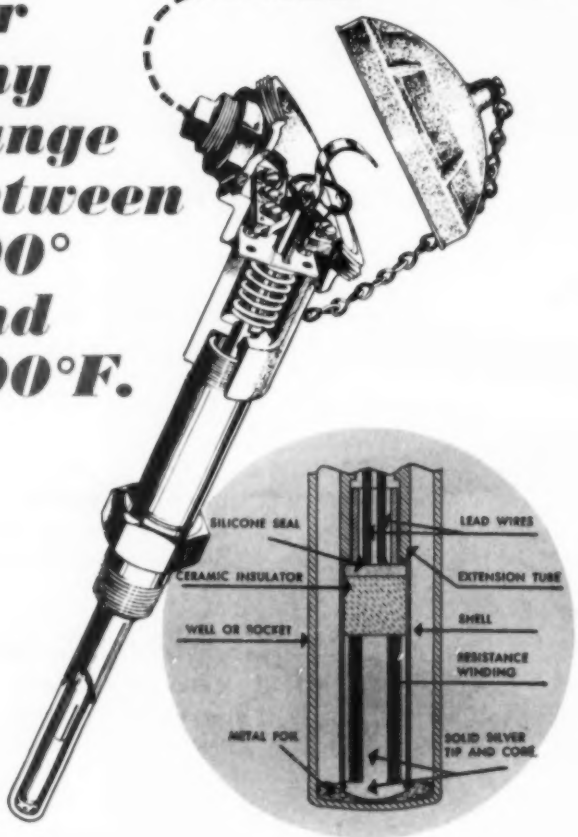
These are only a few of the important advantages of this better temperature measuring system . . . available also for control of temperatures, or with Multi-Record Dynalog Recorder for up-to-6 records on one chart. Write for illustrated bulletins, The Foxboro Company, 749 Neponset Ave., Foxboro, Mass., U.S.A.

for any range between −100° and +600°F.



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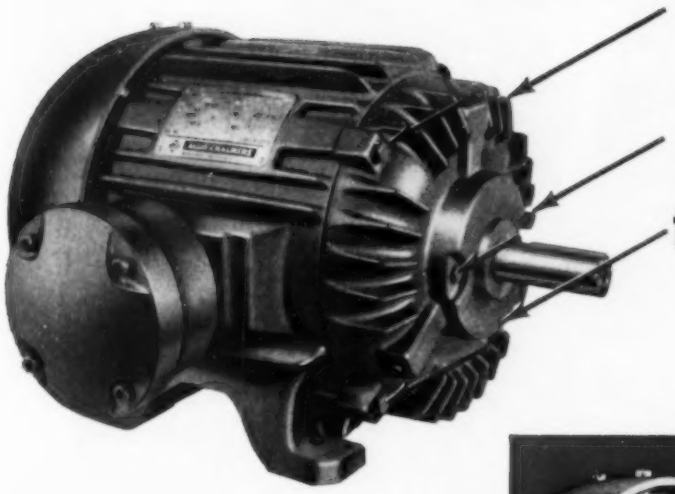
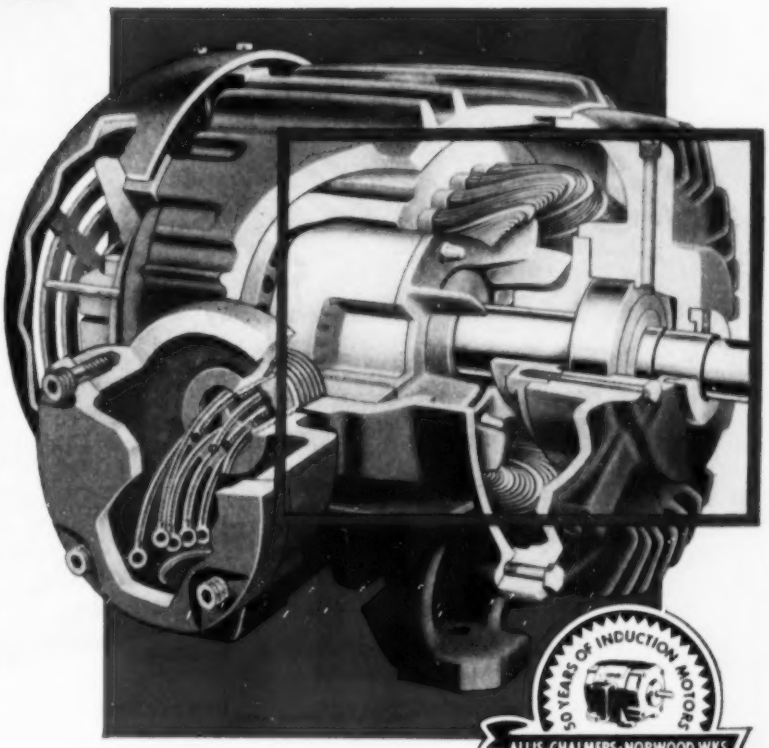


It takes 6 bolts not just 4 to give full bearing protection

THE TWO EXTRA BOLTS in the end housing of every Allis-Chalmers ball bearing motor are the proof of *extra* protection against bearing failure. These are the bolts that hold the bearing cap tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Result? Allis-Chalmers motors pay off in longer, trouble-free bearing life, lower motor maintenance.



Get all the facts . . . judge for yourself — Compare Allis-Chalmers motors with other motors. Get the six-bolt construction that gives you complete bearing protection. For proof, see your Allis-Chalmers Office or Authorized Distributor, or write — Allis-Chalmers, Milwaukee 1, Wisconsin.

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Big boilers for utilities and general manufacturing? B-L's tube supported wall design and Texad* finishes eliminate enclosure structural steel and steel plate casings. That saves plenty on the original cost! Performance? Better than ever!
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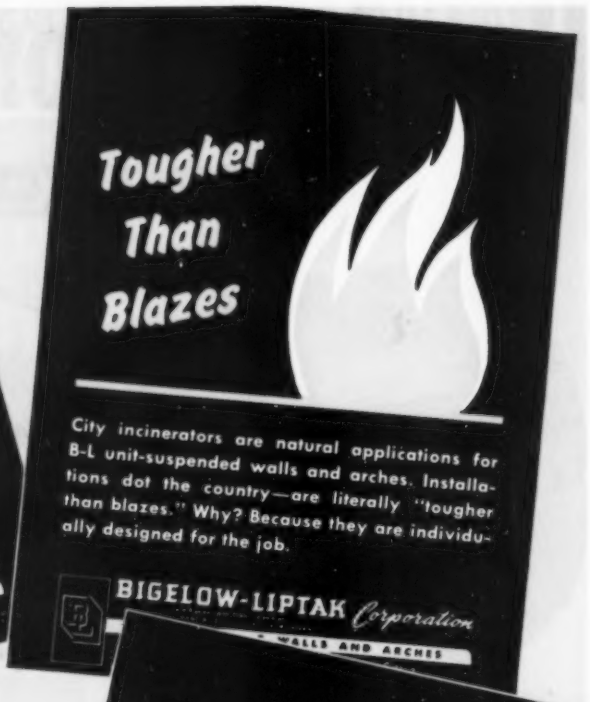
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City incinerators are natural applications for B-L unit-suspended walls and arches. Installations dot the country—are literally "tougher than blazes." Why? Because they are individually designed for the job.
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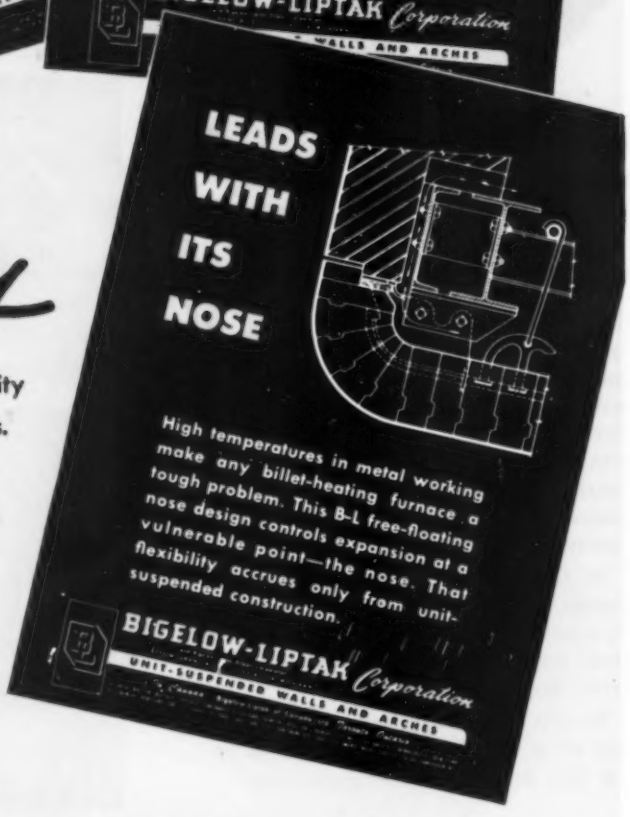
LEADS WITH ITS NOSE
High temperatures in metal working make any billet-heating furnace a tough problem. This B-L free-floating nose design controls expansion at a vulnerable point—the nose. That flexibility accrues only from unit-suspended construction.
BIGELOW-LIPTAK Corporation
UNIT-SUSPENDED WALLS AND ARCHES

Versatility

You'll find that versatility is an inherent quality in B-L's design for furnace walls and arches. Thermal problems—erosion hazards—desired end results—are factors that govern the final design. That's why you see so many B-L installations through industry. After all, they provide long, dependable service at a low, low cost. More information? Write today.

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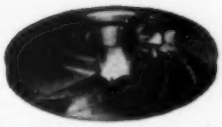
ALLIS-CHALMERS

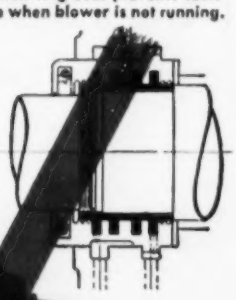
Multi-Stage Centrifugal Blowers

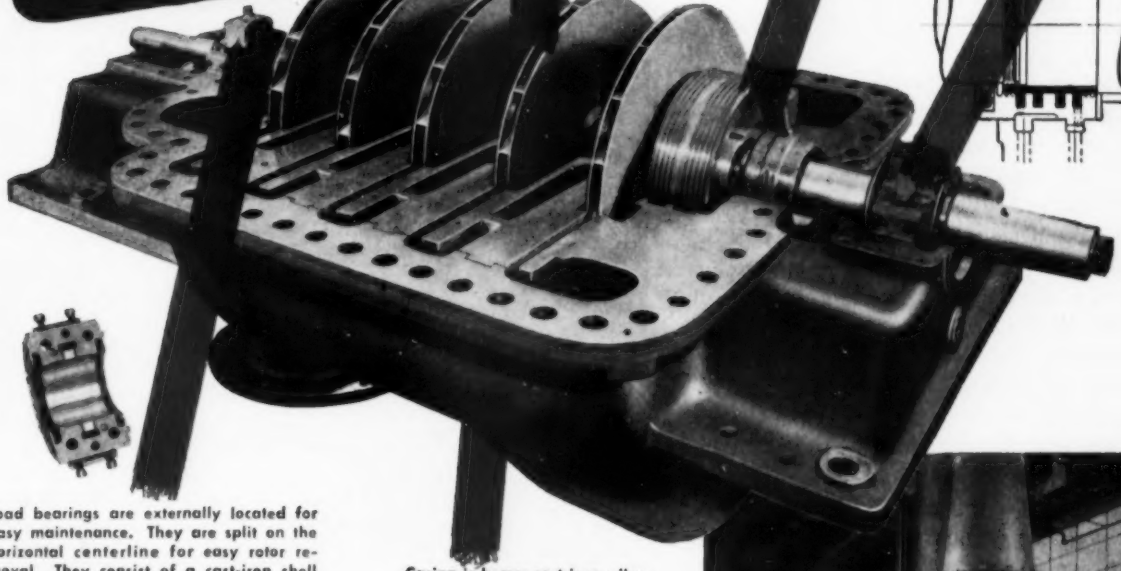


Impeller construction provides unobstructed passage of air or gas. Impellers are furnished in riveted or welded types, as determined by impeller dimension. Note that in riveted impeller wheels, rivets are integral with, and milled from, blade stock.

Impeller wheels are located accurately on shaft with sleeves and are mounted with light shrink fit. Bores are ground to size. Lock nuts prevent axial movement.

Sealing during operation is provided by oil pressure seals. A carbon ring seal prevents leakage when blower is not running.





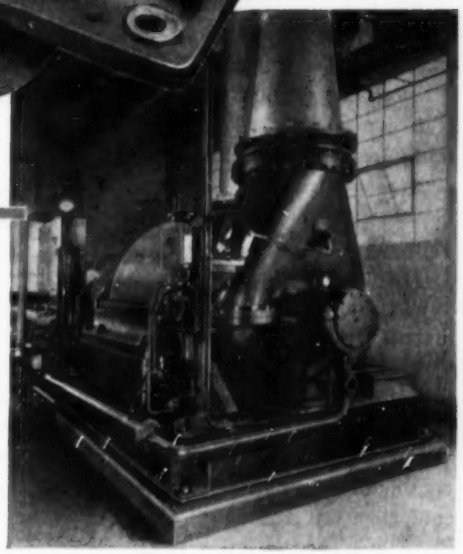
Load bearings are externally located for easy maintenance. They are split on the horizontal centerline for easy rotor removal. They consist of a cast-iron shell with removable, babbit-lined steel inserts.

Casing is heavy cast iron, alloy, or forged steel.

Why these blowers can run for years *without stopping*

The key to "round the clock" performance in fluid catalytic cracking plants is *quality*, as illustrated in the features above.

For highly dependable, low maintenance air and gas handling equipment, as well as motors and control, call your nearby Allis-Chalmers office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4465



This Allis-Chalmers four-stage centrifugal blower supplies 24,000 cfm to the catalytic cracking tower of an eastern refinery on a 24-hour-a-day basis, month in and month out.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

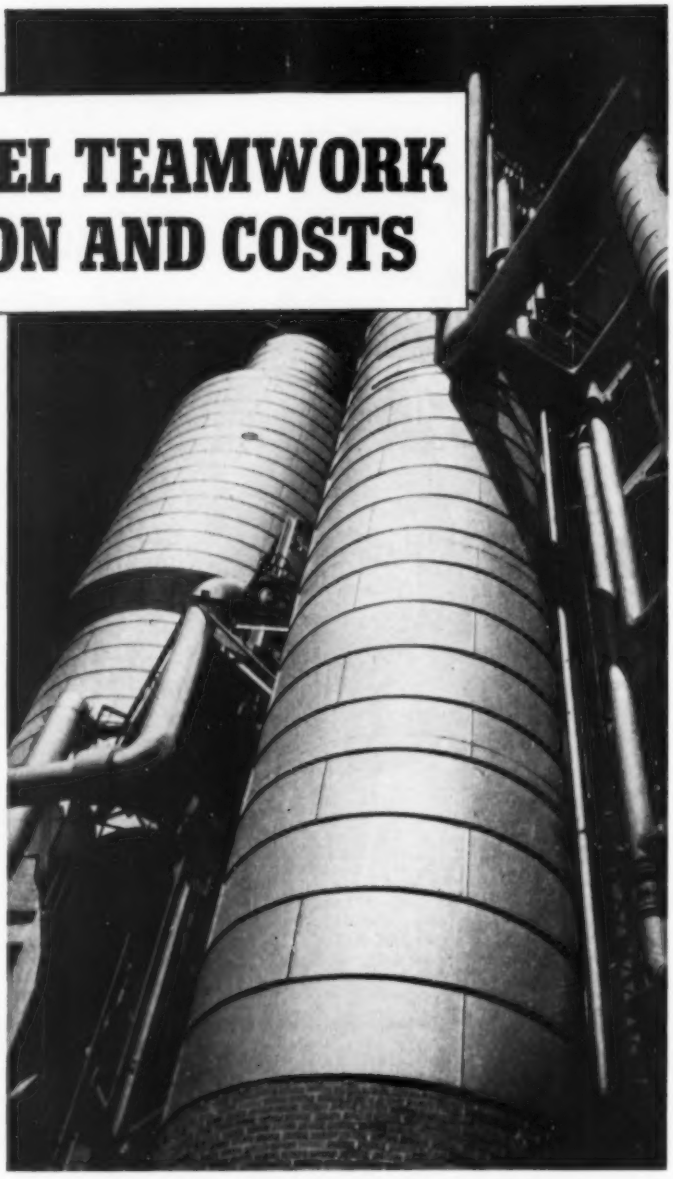
For more data on advertised products, use Readers' Service Cards, last page.

HOW CLAD STEEL TEAMWORK CUTS CORROSION AND COSTS

Selecting material for this two-stage refinery unit was a double-tough problem. The upper section of the atmospheric tower had to withstand the corrosive action of condensing mineral acids and organic chlorides . . . the lower part had to handle corrosive asphalt crude containing up to 2.50% sulphur concentrations. The vacuum still had to process a lube cut at 750°F. The equipment builder solved the corrosion problem *economically* by teaming up two clad steels: Monel-clad for the upper part and stainless-clad for the lower part of the atmospheric tower, and stainless-clad throughout the vacuum still.

With economical clad steel—a layer of solid high alloy permanently bonded over its entire surface to a low-cost carbon-steel backing plate—there is no possibility of seepage or crevice corrosion . . . no costly maintenance or downtime . . . no equipment failure. In addition, clad steels assure resistance to thermal shock, flexible efficient operation, low first cost and easy economical field erection.

Equipment values like these also result from another kind of teamwork. Sound engineering and modern fabricating techniques can take advantage of the versatility of clad steels. You will find that it pays to consult your fabricators *early* in your planning for tanks and pressure vessels. They can work with your engineers and consultants, translate ideas into the specialized equipment you require.



Two clad steels combine specialized talents to lick corrosion in this 20,000-barrel-per-day refinery unit

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 681 Lukens Building, Coatesville, Pennsylvania.

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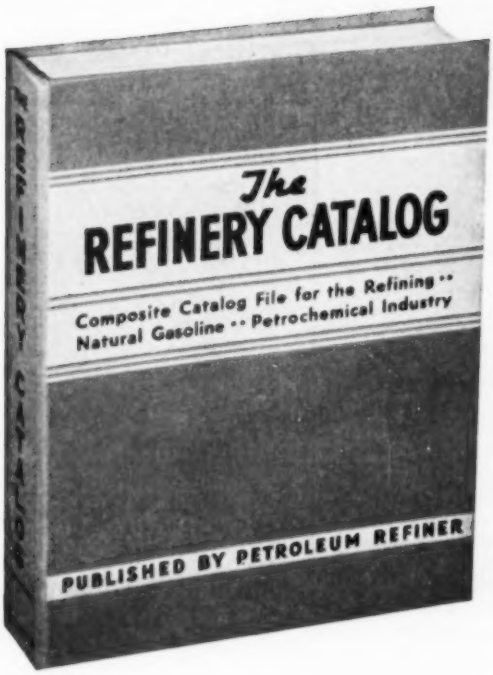
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Eastern Mixers lick the Tough problems . . .

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There's an Eastern Mixer to handle every fluid mixing problem. Whatever your process is, Eastern will work out the problem to your complete satisfaction, and at moderate cost. In nearly every industry engaged in processing of liquids, Eastern engineers have repeatedly scored triumphs over time-distance and material problems.

Eastern mixers come in a variety of sizes and types, from tiny laboratory stirrers weighing less than a pound, to giant bottom mixers. Eastern equipment runs the gamut of needs for effective mixing jobs.

Variable speed laboratory STIRRERS are constructed for hard, continuous usage. PORTABLE MIXERS are available with large variety of shafts in styles, lengths, and mounting arrangements. TOP AND SIDE ENTERING MIXERS with fluid-processing jobs sure of the big jobs. Both propeller and turbine type units are available in a large variety of sizes and ratings.

When contemplating the purchase of fluid mixing equipment, send for Eastern Data Sheets. Our engineering staff will specify the most efficient units complying with the data of your particular problem.

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SIDE-ENTERING MIXER

The Mail Box . . .

Keep Up Good Work!

To the Editor:

In your July issue, you have an article in the "Look Box" which mentions "scotch tape." If you will check, the term "Scotch" should be capitalized since it is registered with the U. S. Patent office.

I really must also let you know that I enjoy each copy of the REFINER that I receive. Particularly valuable to me as a design engineer are your articles on mechanical design such as heat transfer, foundations, piping stresses, etc. I usually remove certain articles from each issue to retain as reference material. Your presentation on manufacturer's products and services are utilized extensively also. Keep up the good work!

Russel A. Holcomb,
Standard Oil Company (Indiana)
3572 Washington
Gary, Indiana

Mixing Reprints on Way

To The Editor:

I have just received a copy of PETROLEUM REFINER for August and am glad to see that my article on "Mixers for Large Tank Blending" is set up so nicely.

In filling my order for reprints will you please see that the titles for Figures 4 and 5, page 103 are interchanged? They appear incorrectly although the text properly refers to each figure.

J. H. Rushton,
Illinois Institute of Technology
Technology Center,
Chicago 16

Ed's Note—Woops, another Gremlin bite! The correction has been made in the reprints and we are also using an Errata in this issue. You will be interested in hearing that Ethyl Corporation also has placed a large order for reprints, commenting "we were quite impressed with the Rushton article."

Jackson Questioned

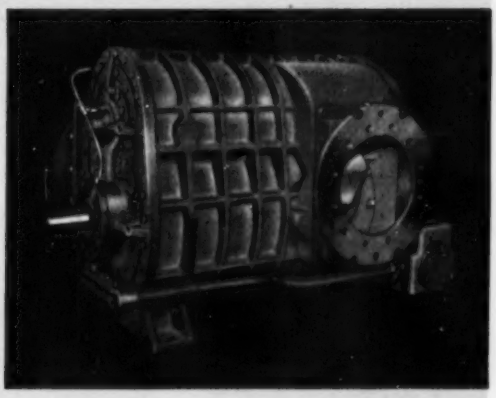
To the Editor:

Your June, 1954 issue of the PETROLEUM REFINER carried an article by Emmett G. Jackson on tower foundation design. This treatise was very clear and concise.

However, there were some few items which might possibly not be standard practice in other refining and process companies. These are as follows: *(Editor's Note: Mr. Jackson's replies are printed in italics below each comment.)*

STABILITY—The ASA Building Requirements publication, "Minimum Design Loads in Buildings and Other Structures" of June 18, 1945, Section 5-9, paragraph (a) quotes as follows: "The overturning moment shall not exceed 66⅔ percent of the moment of stability of the building or other structure due to the dead load only, unless the building or other structure is anchored. The axis of rotation for computing the overturning moment and the moment of stability shall be taken as the intersection of the outside wall line on the leeward side and the plane representing the average elevation of the bottoms of the footings. The weight of

Standardaire® Blowers



eliminate compression pulse-beat or pressure surges

Pulse-beats indicate a healthy heart, but in the refining industry, pulse-beats or pressure surges indicate an inefficient compressor. The *Standardaire Blower* assures refinery users a blower completely free of compression shocks and fluctuating pressures. The *Standardaire* achieves this important feature by its cycloidal form, screw type rotors which draw the air or gas in and discharge it smoothly from the pockets which form between the rotors.

To move more gas or air with less wear, and lower maintenance and power costs, specify the *Standardaire Blower*. Write today for Bulletin B-154.

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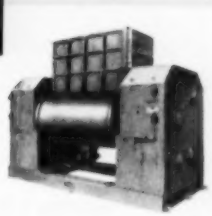
Read Standard also manufactures a complete line of chemical mixers for laboratory and industrial use. For information write, Read Standard Corp., York, Pa.



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Kontol liquid organic corrosion preventives have proved effective and economical as refinery anti-corrosion measures. Very easy to apply, they effectively protect carbon steels, as well as alloys.

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The Mail Box . . .

earth superimposed over footings may be used in computing the moment of stability due to dead load."

In other words, using the leeward edge of the footing as an axis of rotation, the moment of the total dead load divided by the moment due to wind load, should not be less than 1½, which we might call an overturning or stability factor. Only in rare cases does this limitation produce positive soil bearing throughout the footing area.

Answer: *Most specifications require an F of S of 2—depends on the individual specifying.*

ANCHOR BOLTS—The method used in the sample problem was very well illustrated. However, the anchor bolt unit stress employed is quite a debatable item, and most text books and specifications carefully avoid the issue. It is true that the AISC Specifications permit an increase in unit stresses of 33⅓ percent for members and connections carrying wind stresses only, but I believe it is general practice with most designers to make use of the normal 20,000 psi, with a further reduction for initial bolt tension or possible bolt corrosion. Our standard specifications establish a value of 15,000 psi tension for anchor bolts.

Answer: *Again, depends on the specs. As far as initial tension is concerned, I see no need for reduction—but specs usually require a ⅛ inch corrosion allowance.*

PEDESTAL STEEL—The equation for the determination of pedestal steel in the first method is not quite clear. Dividing pounds per square foot by pounds per square inch would hardly result in square inch. It would probably be more appropriate to establish an equation for the section modulus and area of the group of reinforcing bars. The second method is in common usage, but is still not exact, since the lever arm of the wind load is taken from two different elevations in the case of the anchor bolts and the pier bars. However, the added weight of the pier to the vertical load would result in a close approximation.

SHEAR AND BOND—Referring to Figure 3, the pressure diagrams for the determination of shear is a truncated prism, in that the net pressure of 1450 psf is applied over a length of 7.46 feet, and the net pressure of 930 psf is applied over a length of 3.73 feet. The bond stress should be determined from the shear at the face of the pier rather than the plane considered for a diagonal shear. See ACI (318-51) paragraph 1205-d.

Answer: *I stand corrected.*

GENERAL—The statement in the first paragraph of the article is rather dubious. The author does not give any comparison as to the savings of 50 percent in steel. If the reference is to the ACI 1947 Code, the statement is in error, for the method of passing a vertical plane at the face of the pier is repeated verbatim in the current code. The only change in the 1951 code—as far as footings are concerned—is the allowable bond stress.

As a case in point, the shear from Figure 2 amounts to 6630 pounds. Using the ACI 1947 bond stress of 168 psi

See LETTERS, Page 351

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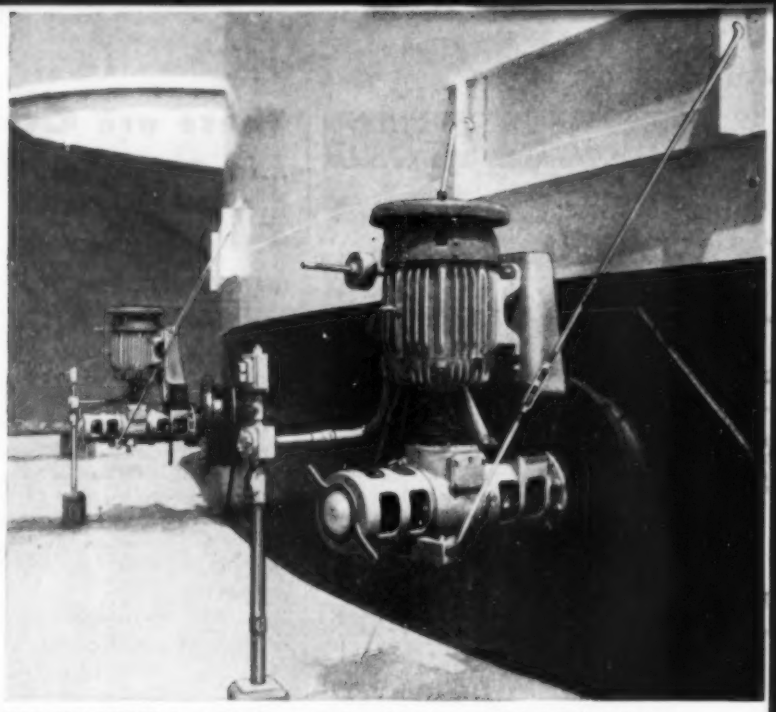
of mixing and blending in big tanks



YOU CAN REPACK the stuffing box or replace the rotary mechanical shaft seal on a LIGHTNIN Side Entering Mixer, under a full head of 5 million gallons—without losing a pint of product.

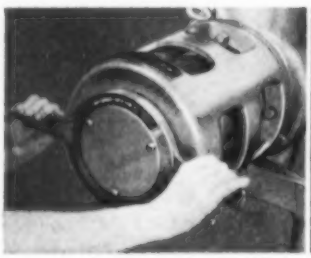
Now you can *choose* the kind of mixer shaft sealing that best meets your operating requirements—gives you the most in trouble-free operating hours . . . in maintenance dollars saved.

1. You get easier repacking than ever with the standard LIGHTNIN packed stuffing box. You need never take the tank out of service to change packing. The mixer shaft retracts like a valve, sealing liquid in the tank, so you can repack in a jiffy and resume operation.

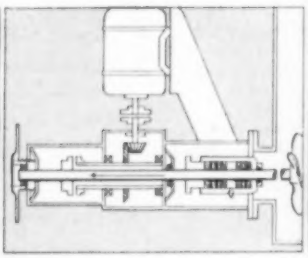
2. You eliminate repacking—for good— with the new LIGHTNIN rotary shaft seal! This seal runs without adjustment for its entire lifetime. When it finally wears out, you can replace it in a few minutes—by changing one simple cartridge component!

These are *two* good reasons why it pays to specify LIGHTNINs for blending, treating, TEL addition, bottom sediment control in crude storage tanks, and other big mixing operations.

For quick, competent help—and fully guaranteed results—on *any* fluid mixing job, big or small—call in your LIGHTNIN representative. Or write us today.

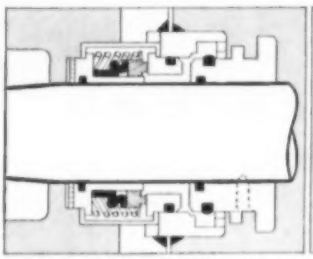


STUFFING BOX repacking is fast, simple. Turning this easy-to-get-at bearing member...

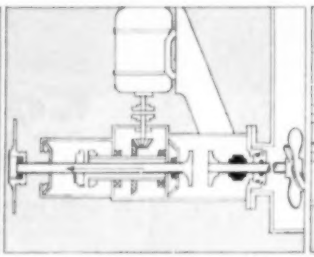


...retracts the mixer shaft outward, like the stem of a valve. Inside the tank...

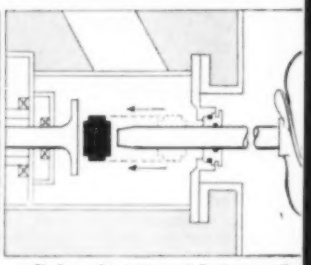
...a Teflon "O" Ring squeezes against the shaft and flange hub, keeping product safely in the tank while you change packing.



ROTARY SEAL ends repacking—forever. Seal runs without adjustment for its lifetime. Easy to replace, too...



...Shaft comes apart. Tank end of shaft locks in place and seals liquid safely in the tank...



...Shaft coupling is removed. Seal comes off as a unit. New seal goes on as a unit. In a few minutes, you're back in operation.

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The LOOK BOX for September . . .

New Man on Maintenance

NEW ADDITION to the editorial staff of PETROLEUM REFINER is Ray Shannon, who has taken over the reins in Maintenance and Design. Ray's past accomplishments speak convincingly of his ability to direct REFINER's complete coverage of the fast moving developments in these fields.

Shannon

Following his graduation from the University of Texas with a B.S. degree in mechanical engineering, Ray cast his lot with Magnolia Petroleum Company at Beaumont, Texas. As an undergraduate at Texas he distinguished himself by winning membership in Tau Beta Pi, and since graduation he's been amassing an enviable record at Magnolia, first in the Maintenance department and subsequently in the Engineering department. His assignments have ranged from corrosion inspection and control and study of new maintenance methods for many types of refinery process equipment to design of all types of process units, equipment cost estimating and purchasing, and project development in Engineering. In each assignment Ray gained further recognition for his already proven ability. His position prior to joining REFINER was project engineer.

On top of everything else, Ray's fellow engineers in the large Sabine River industrial region wrote yet another bright entry into his record when they elected him chairman of that section of ASME.

One of Editor Shannon's big assignments will be to head up the annual Maintenance Special Issue. Typically Texan, Ray is somewhat calculated in his conversation; but already on the Maintenance Issue his exuberance has bubbled through that stolid veneer. Maintenance and design people will likely be hearing from him soon.

Publisher Ray L. Dudley, from a vantage point gained through 35 years of publishing business papers, made this observation: "The addition of Ray to the staff is consistent with the traditionally high quality PETROLEUM REFINER maintains for its subscribers. Ray's background in maintenance and engineering equip him well for his new duties. PETROLEUM REFINER is on the move, its circulation has jumped 46 percent in the last two years. Staff members of proven ability such as Ray insure the continuance of that growth."

PETROLEUM REFINER Editorial Director Robert J. Phillips, one-time holder of Ray's new position, knows Ray and knows the job. His views: "We intend to expand our activities in maintenance and design to maintain our present leading position. Ray figures prominently in those plans. He's a natural; there's no doubt he'll do an excellent job."

What Price Benefits?

THE UNITED STATES Chamber of Commerce last month rendered another priceless benefit to management by supplying statistics on fringe benefits received by U. S. workers.

Although fringe benefits have been a steadily increasing factor in management-employe relations, their importance was largely ignored until 1947, when the Chamber made the first of its surveys. The studies have been repeated biennially at the request of employers eager to give employes an appreciation of the cost of fringe payments, which are now estimated at $20 to $25 billion a year.

The Chamber's most recent report was based on a study of benefits costs—employer payments for social security, pensions, vacations and the like—in 940 companies. In 1953 these costs amounted to $720 per employe, which was $76 higher than two years ago.

The payments varied widely according to types of industry, ranging from less than 5 percent to more than 55 percent of payroll. In the refining industry, the benefits came to 24.5 percent of total payroll, compared with 19.2 percent for all industries and 16.8 percent for other manufacturing industries.

The Chamber's survey of 18 oil companies revealed the following breakdown of fringe payments, as percent of payroll:

Legally required (employer's share only) 2.1 percent; pension and other agreed-upon payments (employer's share only) 10.7 percent; paid rest and lunch period—0.6 percent; payments for time not worked—8.8 percent; profit sharing payments—2.3 percent.

Refining's total fringe payments as cents per hour came to 56 cents, compared with the national average of 34.6 cents, or $1178 per year per employe.

Thanks in large measure to a splendid group

New Grease Thickener...
Estersil GT
by Du Pont

A new type of grease thickener—quite different from any previously used in commercial grease production—was recently announced by the Petroleum Chemicals Division of the Du Pont Company.

The new material, an estersil, is a pelletized form of finely divided amorphous silica with a "raincoat" chemically attached to each tiny ultimate particle.

Formerly known as PL-171 FINE SILICA, it is completely synthetic and was specially developed for grease compounding. "Built-in" water resistance and exceptional thermal stability are among its unusual and outstanding properties.

NOW—with Estersil GT you can easily prepare a unique multi-purpose grease with the basic advantages listed below . . .

1. Excellent Thermal Stability—Nonmelting Estersil GT greases show little change in consistency over a wide range of operating temperatures.

2. Excellent Shear Stability—This new thickener enables you to make greases with exceptional shear stability under *both* normal and *high* temperature conditions.

3. Water Resistance—The chemically bonded "raincoat" means greases with unusual resistance to wash out or break down in the presence of water.

4. Superior Oxidation Stability—The need for grease antioxidants is eliminated under most service conditions because of the inertness of Estersil GT.

5. Superior Handling Qualities—Softer, more easily applied greases can be used for high temperature service because of the combined mechanical and thermal stability imparted by Estersil GT. These softer greases, of course, are more readily handled at low temperature than the more conventional types.

6. Ease of Manufacture—The completely synthetic preformed thickening structure allows reproducible grease preparation through a simple milling operation.

Du Pont will be glad to send a representative to discuss the formulation of improved greases with Estersil GT. A grease pilot plant is available to assist in this work. Samples of Estersil GT may be obtained by addressing your inquiry to Wilmington, Delaware.

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of company magazines, the oil industry has not been as remiss as some of the others in explaining to employes the tremendous—and voluntary—contributions to their welfare. And as one direct result, oil is the only remaining major industry in the U. S. which has resisted the efforts to organize its workers on a nationwide basis.

Higher and Higher Tax Mountain

"TREMENDOUS burden," the term applied by the American Petroleum Industries Committee to the oil industry's $5 billion tax bill for 1953, seems most conservative if not actually an understatement.

The $5 billion represents nearly a five-fold increase on the petroleum industry and its customers during the past 20 years. We'd say right quickly that this appears to be a full share.

An analysis of last year's oil industry figures shows, the APIC points out, "that it was not unusual for a company to pay more in taxes than it paid in dividends to stockholders," and "it was also not unusual for the tax burden to exceed the total wages paid to all its employes."

Here is the "altitude" of the ever-increasing mountain of taxes met by the petroleum industry during the 20-year period ending last year:

1933	$1,004,824,000
1938	$1,286,114,000
1943	$1,686,133,000
1948	$3,363,304,000
1953	$4,939,056,000

Improvement Seen In Industry Position

CONSIDERABLE improvement in the industry's economic position occurred during the past month. Lowered refinery operations resulted in reductions in finished product inventories, particularly in gasoline stocks.

Biggest improvement was the reduction of gasoline in storage. Motor fuel stocks dropped from 165⅔ million barrels to 155 million from the first of July to the middle of August. This reduction of 10⅔ million barrels in stocks was more than twice the withdrawal rate during the same period of last year, but was fairly well in line with withdrawals in years prior to 1953.

Despite the large reductions in gasoline inventories of recent weeks, stocks were still above all previous years. However, the spread has been reduced substantially. At the end of the third week in August, gasoline on hand was 14½ million barrels above year ago levels and 39 million above supplies of two years earlier. However, that was the lowest margin of gain over last year to exist so far this year, contrasting with 18⅔ million barrels at the beginning of the heavy motoring season at the first of April and 19½ million in early July.

Inventory improvements developed from reduced crude runs to stills and the resulting lowered gasoline output. During the five weeks ended August 20 refinery runs to stills averaged slightly more than 6¾ million barrels daily, while almost 7 million per day were processed during the preceding five-week period. Gasoline production was 26,000 barrels a day less in the latter five weeks.

Red On Black Coal

DID YOU KNOW that coal (that black stuff) is getting dressed up? Neither did we until we ran across an item in the August-September issue of *Du Pont Magazine*, one of the publications of E. I. duPont de Nemours and Company. It seems that one coal company wishes to identify its coal. Anthracite coal would normally be very uncooperative in such an endeavor, being uniformly black. The solution is to give it a number of small red spots by spraying red paint on it after it has been washed and broken to size.

All this may sound somewhat odd to us oil industry folks. Odd, that is, unless we remember the money spent each year to alter the natural color of gasoline. Gasoline, of course, has taken one step further—its color is completely changed in most cases. The days of the old style service station pump where you could see the gasoline enclosed in a large glass container at the top of the pump are essentially gone, but the addition of dyes goes right on. This, in spite of the fact that hardly any gasoline-buying customer ever sees the gasoline nowadays with the use of the modern pumps at the service stations.

How to Get Ahead, some sensible rules for business success, appeared on this page a month ago and many readers have requested extra copies. If you'd like some for your employes or others, just let us know.

ETHYL RESEARCH BUILDS A "WHIRLING PIN CUSHION"

to probe the secrets of combustion deposits

A special whirling disk developed by Ethyl research people may help technologists come up with the answer to one of the "hottest" problems facing the petroleum and automotive industries.

The problem: Exactly what can be done about the deposits that build up in the combustion chamber of a modern gasoline engine?

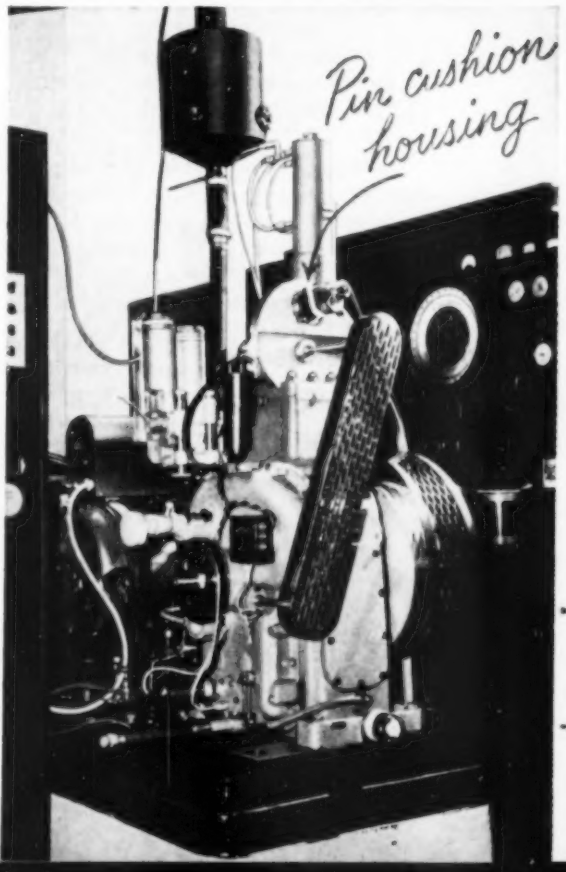
Only when researchers can understand what they are and how they form through the interaction of fuels, oils, additives and the metals of the engine, will it be possible to render these deposits harmless.

Ethyl research people have been at work on the problem for years and in many different ways. Recently, they made another step forward when they developed an amazingly simple test instrument they affectionately call the "whirling pin cushion."

By spinning the pin cushion in a special test rig, researchers are now able, for the first time, to trace the step-by-step formation of combustion products—at all phases of the cycle.

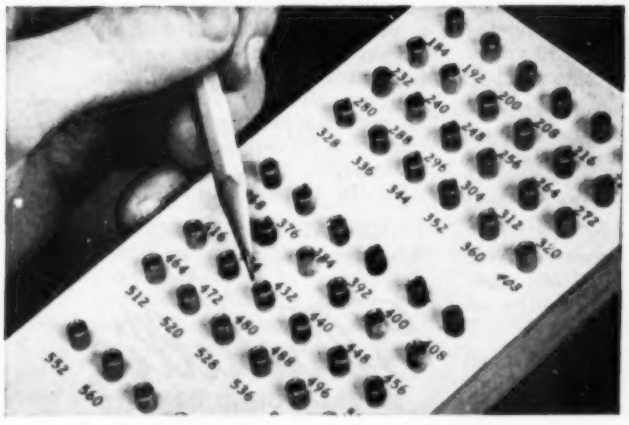
This is another milestone in basic research on combustion-chamber deposits.

New test instruments at Ethyl Laboratories like the "whirling pin cushion" are helping us piece together the fundamental knowledge which will eventually open the door to engines and fuels of far greater efficiency than are possible today.



Special test engine synchronizes the "whirling pin cushion" with the engine cycle so that each pin picks up deposits from exactly the same portion of the cycle each time.

Sampling "pins" on Ethyl's "whirling pin cushion" move past a specially constructed opening in the cylinder head of a test engine and pick up combustion deposits—as they are being formed.



Each pin on the disk accumulates deposits formed.

Ethyl laboratories "fingerprint" the deposit on each sampling "pin" by X-ray diffraction.

ETHYL CORPORATION
Research Laboratories

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Flexitallic Gaskets are exclusively spiral-wound, the uniquely resilient construction pioneered by the Company in 1912.

Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". In diameters to 84" O. D.

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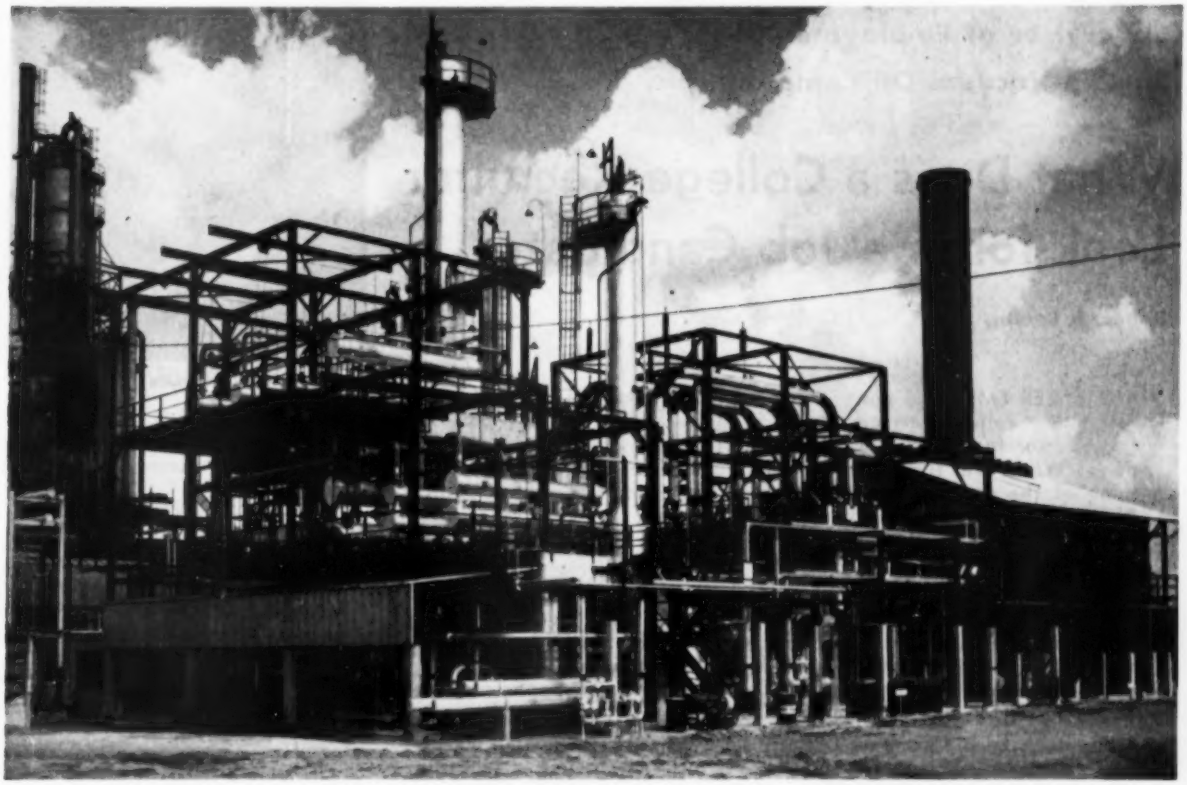
*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

Who's Building . . .



Pan-Am Southern's new Ultraformer was completed ahead of schedule.

First Ultraformer on Stream

Pan-Am starts up 7300-barrel-a-day unit at El Dorado after only 147 days of actual construction.

The first commercial scale Ultraformer for the upgrading of light fraction charge stock into high octane gasoline went into operation last month at El Dorado, Ark. Startup came only 147 actual working days after construction began.

Builder of the unit in record time for Pan-Am Southern Corporation was Lummus Company, of New York, designing engineers and constructors for the petroleum and chemical industries.

The new unit, accepted by Pan-Am Southern after initial operation of 20 days, processes 7300 barrels a day of feed stock at 300 psig, yielding gasoline of better than 90 octane. For its schedule beating construction job, Lummus collected a 46-day bonus from Pan-Am Southern.

Ultraforming is a fixed-bed catalytic reforming process employing a special technique for cyclic regeneration of the catalyst. The process was developed and is licensed by Standard Oil Company (Indiana). A platinum-based catalyst is used which is restored to full activity and selectivity at intervals varying from a week to a few months, depending on the severity of the operation and the age of the catalyst.

Standard of Indiana Sets Mandan Refinery Opening

The new 30,000 barrel-a-day refinery built by Standard Oil Company (Indiana) at Mandan, N. D., will be dedicated early next month. Governor C. Norman Brunsdale of North Dakota will give the dedicatory address at public ceremonies beginning the morning of October 2. Top executives of the company will take part in the program.

In addition to the official dedication ceremonies, refinery guides will conduct the visiting public on tours of the plant.

The Mandan refinery is North Dakota's newest and largest industrial plant. Opening of the plant is one more step in the gradual development of the Pacific Northwest as a major refining center.

Principal products to be made from Williston Basin crude oil at the refinery will include all grades of motor gasoline, kerosine, heater oil, diesel fuel, furnace oil, power fuel and industrial fuel oil.

More Construction Items Page 333

A Petroleum REFINER Interview

with PAUL W. BOYNTON

Supervisor of Employment,

Socony-Vacuum Oil Company, Inc.

What Does a College Recruiter Look for in a Job Candidate

Robert E. Spann,
Petroleum REFINER Staff

Boynton

GREATER EMPHASIS has been placed upon recruiting job candidates direct from colleges in recent years. While recruiting has been done in this manner for about three decades the practice became widespread during World War II and the immediate postwar period. To learn something of the real value and purpose of these programs, PETROLEUM REFINER interviewed Paul W. Boynton, Supervisor of Employment for Socony-Vacuum Oil Company, Inc.

Boynton is the unofficial "dean" of the college recruiters, or ivory hunters, as they have been called. Boynton established the formal college recruiting program for Socony-Vacuum 25 years ago. Recruiting of personnel has been his career for more than 30 years, during which time he has interviewed more than 100,000 job applicants. Boynton's department annually averages interviewing more than 6000 applicants and answering letters from a total of 10,000 persons seeking employment.

Boynton's book, "Six Ways to Get a Job," is used in many high schools and colleges throughout the nation. He is also the author of "Selecting the New Employe" and "Six Ways to Retire."

Q. *Mr. Boynton, why do many companies have college recruiting programs?*

A. Theoretically, the colleges are a reservoir of the nation's best brains. Also, the distance the students can travel in search of employment is limited by financial reasons, so it became necessary for the industrial recruiter to go to the campus. Furthermore, it is desirable to broaden the geographic representation in the company.

Q. *Is there much competition between companies in hiring college graduates?*

A. Yes, indeed! It is estimated that between 4000 and 5000 companies now have college recruiting programs. The competition for men, particularly those in the upper third of the graduating classes, is rugged.

Q. *You indicate in your answer that there still is a shortage of college graduates. Is that true?*

A. Yes, in a few categories. For engineering graduates, for example, there are still about three times as many jobs as there are qualified applicants. The rate of increased enrollment in engineering schools indicates, however, that the number of graduates will become more in balance with job openings in about three years—barring any sudden shift in business conditions.

Q. *What types of job openings do you offer the college students?*

A. We are hiring across the board for nearly all of the departments in the company. Our largest number of openings are for engineers and non-technical sales trainees.

Q. *What type of person are you seeking to fill these jobs?*

A. We are looking for men who in 5 to 10 and 20 years hence will be able to fill executive positions in the company. I might add here that we do not feel that colleges have a monopoly on brains or that a man can't move up the ladder in this company unless he's a college graduate. Every employe is eligible for promotion according to his abilities and many non-college people have advanced to high executive positions.

Q. *How do you appraise applicants to find these future executives?*

A. One of the most important factors in the interviewer's appraisal is to determine whether the candidate can manage other people. This is equally important with technical ability. The best job candidate is an intelligent person who has had well rounded training. Participation in extracurricular activities is as important a factor as a good scholastic record. An experienced recruiter can look at a man's written record and pretty well determine what he will do and just about how far he will go in his career—barring any unusual emotional upsets. Any individual is the sum total of his experience to date, and if you would judge the future, it is wise to look into the past.

Q. *How many college students do you interview each year?*

A. We average interviewing between 1500 and 2000 students annually, although some of these are just seeking information to make comparisons with job openings in other companies.

Q. *About how many colleges do you visit each year?*

A. We visit about 75 colleges on the average, and sometimes it is as high as 100, depending on the number and type of jobs to be filled. These colleges are located all over the country. This year, for instance, Socony-Vacuum had four teams constantly in the field. Each team consisted of a trained college recruiter,

See COLLEGE RECRUITING
Page 387

Hate rumor . . .

Bogey rumor . . .

They close banks and start riots . . .

You must learn to stop them . . .

Because . . .

Pipe dream rumor . . .

Rumors Can Ruin You!

Auren Uris,
Research Institute of America,
New York.

RIOTS HAVE been started, banks have been forced to close their doors, companies have folded, because somebody whispered a vicious word.

Wherever the winds of rumor blow freely—in plants and offices—they leave a trail of upset and turmoil.

Key word of a rumor may be layoff - bankruptcy - reorganization. Such sparks can lead to conflagration. The fact is, rumors can undermine the foundations of group loyalty and team spirit. Unhindered, they can destroy the team—even the ball field.

The dictionary defines rumor as "a story current but not authenticated—something believed but not proved." But that doesn't give you the true picture, the insight into the nature of the beast. You can usually nail down a lie; but a rumor is like poison gas—in the way it spreads, the difficulty of fighting it, and the harm it can do to the people in your organization.

It's this intangible quality that makes a rumor difficult to handle. The man who thinks it's easy is usually the one who does more harm than good in his efforts to counteract the poison.

Types of Rumors—Generally, rumors fall into three main categories:

. . . the bogey rumors—founded on fear;

. . . the pipe-dream rumor—based on wishful thinking;

. . . the hate rumor—a mixture of fear and malice.

I. The Bogey Rumor. The phone rang in a company president's office. It was his personnel director, obviously upset: "People are quitting all over the place, and I can't figure out why."

An investigation disclosed that a few days before, in a casual conversation, one employe happened to mention to another that he had heard the company was going to lay off 10 percent of its personnel across the board. By the afternoon, the rumor was all over the place, and instead of 10, it was now 50 percent layoff.

No layoffs were planned. But that fact didn't halt the damage.

Behind the bogey rumor you usually find insecurity. It's the man who's uncertain of the future who grabs a crisis out of the air, starts the panic words on their deadly rounds.

You might say, he sees the world through black-colored glasses. He sees in the man who has come to fix a bad floor board, the first of a wrecking crew that's going to rip down the building; a light burning overtime in the front office is taken to mean the company's in trouble.

II. The Pipe Dream Rumor—A week before Christmas, one employe told another everyone would soon be feathering his nest with a bonus amounting to 10 percent of the yearly salary.

Actually, management, as it had in previous years, declared a 2 percent bonus. The let-down—and the resentment—was terrific.

Behind the pipe dream rumor you're apt to find a frustrated individual. He craves adventure, excitement, anything to break up the routine. At the wheel of the family jalopy, he thinks of himself as a jet pilot. He daydreams, mentally acquires all the things he'd like to have—a date with his favorite Hollywood star, a million dollars, the boss's chair.

And all too frequently, it's but a step from an idle thought to an idle tongue.

Let's say someone in the department is going to be promoted. To our pipe dreamer, it's simple logic that, "When they move him up in line, that will mean promotions for all the rest of us." And he starts the juicy item through the grapevine.

III. The Hate Rumor—Mr. X, an employe of six months' tenure, has been trying desparately to make the

grade. But one day he tells his boss, gruffly, that he is quitting—and promptly does.

Later it comes out that the man had been hounded by a persistent rumor that pictured him as a petty thief.

True, a number of small items had been disappearing from the men's locker room, but none of these thefts had ever been connected with the man who had quit. Nevertheless, the rumor had flourished.

Six months later the true story came out when the real thief was caught.

Who had started the original rumor? Clearly someone who, for one reason or another, "had it in" for Mr. X.

The character assassination rumor is the easiest to spread, the hardest to curb. A man's reputation can be ruined overnight. Behind such destructive whispering campaigns you'll usually find a man with a peeve—or worse, a "professional" hater. He devotes an inordinate amount of time to resenting those who are more successful than he is—or merely different.

Troublesome Twosome—Regardless of the type of rumor you're dealwith, it takes at least two people to start the eight-ball rolling.

First comes the rumor starter. He's the one who makes up the rumor out of whole cloth—or, psychologically speaking, out of the mental projections of his insecurity, his day dreaming, or his pet hates.

Next in line comes the rumor repeater. He parrots the tale the rumor starter has built up. Unfortunately, most of us fit into this category.

Generally, there's no malice behind the passer's talk. But that doesn't lessen the harm he can do. Keep these two links of the grapevine chain in mind when you set out to try to counter-act rumors.

How to Fight a Rumor—Fighting a rumor can be a tough, heart-rending battle. In some cases, you can't win. There are some things you can do, some things you can't, and some you shouldn't, when destructive rumors appear on the scene.

Here are some of the steps which can help you, in certain instances, root out rumors. But they are not fool-proof measures. Sometimes they will work, sometimes they won't. Nevertheless, they are worth considering when you're up against a rumor situation:

• Fight it or forget it? When the story comes to your attention, the first thing you have to do is to decide whether or not it's the kind of rumor you have to fight. There are a few simple standards by which you can judge:

. . . Are people taking it seriously? Sometimes a story gets around without anyone taking it very much to heart. It may even be a gag—which will be accepted as humor, as long as tempers don't get short.

. . . Is anyone being hurt? Funny or not, if an individual is under attack, you may have to take action to protect him.

. . . How widespread? Some rumors spread all over the place, others are restricted to a small group. The extent to which a rumor has spread is another factor in helping you judge whether you need to take action.

• What are the facts? Your first step is to learn the actual facts, if possible. The nature of the rumor itself usually tells you where to look. A rumor about John Jones, for example, means that he would be the starting point of your investigation.

• Should you play private eye? It's unwise to try to play detective in handling rumors. A better bet is to call in the key people involved and talk to them either individually or collectively, on a cards-on-the-table basis.

• What's your strongest weapon? Frequently, the simple truth is the best way to give the lie to a rumor.

You can usually stop a rumor cold by—

. . . convincing your people of the falseness of the story;

. . . making them recognize the harmfulness or unfairness of the story.

• Can you straighten out a distortion? Here's a rumor that was brought to one executive's attention:

"We've heard that Mr. X is going to be fired because the company thinks he's too old. That's unfair and we're circulating a petition to protest the move."

Frequently, it's the half truth that causes the most trouble. You may be able to set the record straight:

"Yes, it's true that Mr. X is leaving, but the reason is that he's incurably ill. Don't you agree that under the circumstances it would be best if the whole thing were kept quiet?"

• Can you track down the source? Don't think it's easy. The trail to the den of the rumor starter is lined with pitfalls. More often than not, as you try to follow the trail, you come to a dead end:

"I heard somebody in the lunchroom talking about it, but my back was turned and I didn't recognize his voice."

But try this approach, based on your knowledge of the three types of rumors.

First, label the rumor—bogey, pipe dream or hate variety. Check your last source, and find out his source. Then, since you've labeled the rumor, you have an idea as to the kind of individual who's at the bottom of it.

Even where the trail ends in a cloud of dust, it still may be possible to spot the offender, if you know your people well enough. In the hate rumor, which is essentially the character assassination of one Don Doakes, let us say, you know where to look if you know some of Don's personal enemies.

But—don't be too quick to pin the blame on any individual. In 50 percent of the cases you'll probably be accusing an innocent person. And even if you have the right man, you may have no proof. Your most effective strategy may be to get close to the source, get close to the rumor starter, and then quit. If he can take a hint, you may have permanently ended his rumor-mongering.

Handling the Rumor Starter—When you succeed in tracing a rumor back to its source, your best strategy is generally indirect, long-range. The chief advantage in spotting the rumor monger may lie in preventing a next time.

Where you determine, for example, that your rumor starter is operating from a basic insecurity—via the bogey man type of rumor—you may be able to make the moves that can relieve some of the burden of anxiety that starts his fabrications.

If the culprit turns out to be a pipe dreamer, you may conceivably be able to bring him down to earth, start him on the way to the realistic accomplishment of his goals.

If you find you have traced a "hater" at the end of the line, your problem is a little different and a little tougher.

He's apt to be the one with the most serious emotional difficulty. Chances are you won't be able to change the way he thinks or the way he feels.

Yet a heart-to-heart talk can sometimes do the trick. Don't lecture him—although with some individuals, pointing out the unfairness of their actions, may hit home. If you get no sign of agreement or cooperation, you may have to put it to him squarely:

"We can't stand for that kind of

See RUMORS
Page 385

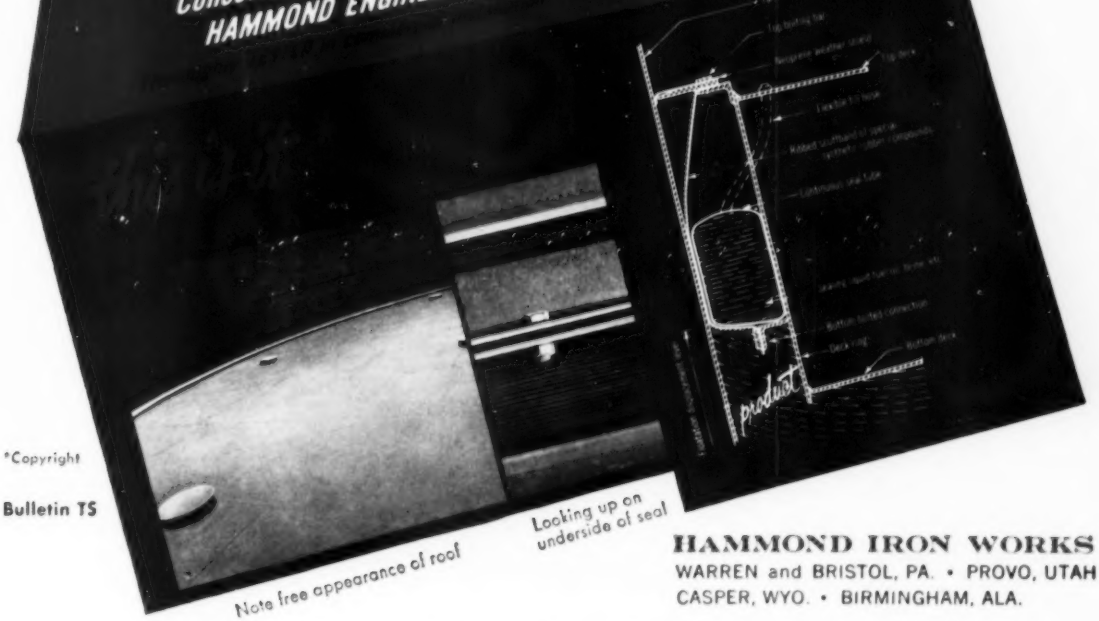
HAMMOND ANNOUNCES ITS TUBESEAL SYSTEM FOR FLOATING ROOF TANKS

new or old—riveted or welded

THE MOST EFFICIENT AND POSITIVE SEAL KNOWN

1
2
3
4
5 non-corrosive
6 ...seal operate to bottom of tank ...ge above the top
7 ...no vapor space below the seal
8 ...entire circumference has tight seal ...under pressure at all times

Conceived years ago but only made possible by combining HAMMOND ENGINEERING and MODERN MATERIALS



Note free appearance of roof

Looking up on underside of seal

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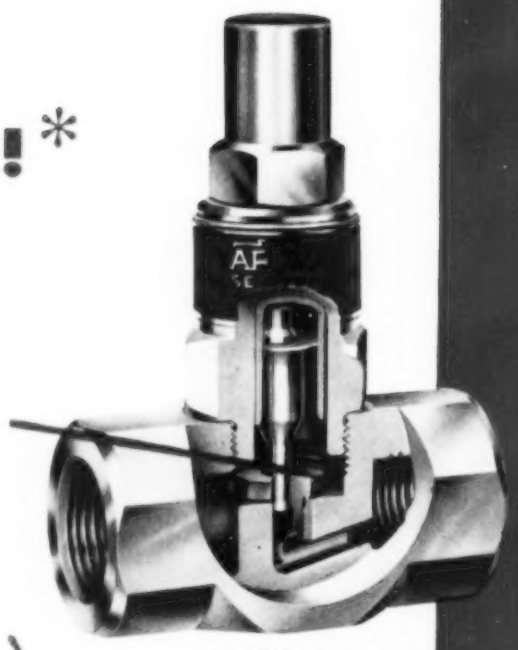
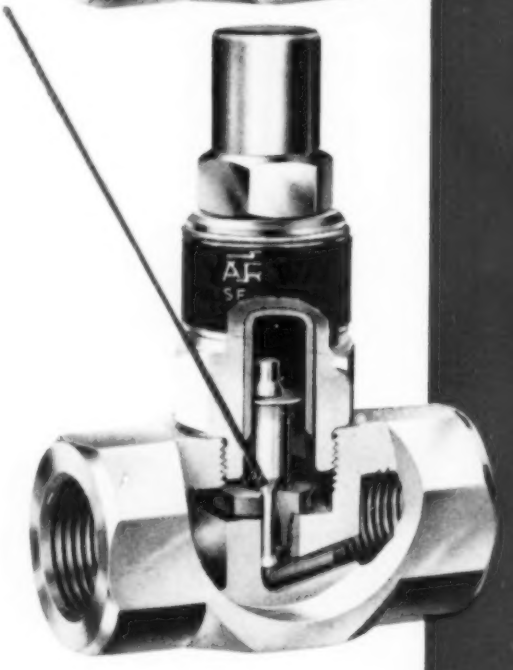
IT FLOATS ON THE LOAD! *





You turn on the steam.

This little stainless steel valve—the only moving part in the Yarway Impulse Steam Trap installed on the equipment—opens wide and *stays* open as the air and condensate continuously pour through.

The equipment reaches production temperature in the quickest possible time.

Production temperature reached, the little valve snaps shut. After that, by a pulsating action, it discharges all condensate as it forms—even a tiny teaspoonful. *There's hot steam in the equipment all the time . . .* steady, maximum temperatures are maintained.

It all adds up—to more production per day.

Other profit-making features of the Yarway Impulse Steam Trap—low initial cost, easy installation, stainless steel construction, low maintenance, good for all pressures, quick delivery from over 200 local industrial distributors.

Try a Yarway—free for 60 days—and *prove* its advantage. Your distributor will supply you.

For free Yarway Impulse Steam Trap Bulletin T-1740, write . . .

YARNALL-WARING COMPANY
128 Mermaid Ave., Philadelphia 18, Pa.

* . . . *resulting in fast heat-up of equipment, more production per day.*

YARWAY | impulse steam trap

Foreword

THE 1954 Process Handbook marks another banner edition in this annual compilation of refining processes. Beginning with the first edition in 1932, the REFINER staff has chosen certain years to present a complete handbook of the most important processes used in the industry. During the intervening years, the Process Issue has been devoted to only the most important developments in processing. The 1954 edition is unique in that it represents the most complete handbook to processing in the industry. Replacing our last handbook edition in 1952, this edition brings every process up-to-date and introduces the very latest processes.

What is the refining process picture today? Crude runs to stills will probably average 7,041,000 barrels daily, an increase of 41,000 barrels or 0.6 percent over 1953. Capital expenditures for refining will rise to $846,000,000, a healthy 19.3 percent increase over 1953. About three-quarters of this investment will go for improving product quality. Process-wise this means a high level of activity in the construction of new process units.

The leading process in product quality improvement is catalytic reforming. During the year Standard Oil Development unveiled its Model II Fluid Hydroforming process and Standard Oil Company (Indiana) its Ultraforming process. Socony-Vacuum has added a fixed-bed process to its line, Sovaforming. This year also has seen the completion of the first commercial installation of Ultraforming. Yet to be completed are the initial installations for Hyperforming, Sinclair Catalytic Reforming and Thermofor Catalytic Reforming. There are now eleven processes to choose from.

All this reforming activity has been generated by the increased demand for quality gasoline to meet the needs of high compression ratio automobile engines and the competition of additive gasolines. Recent estimates indicate that 99.7 research octane number premium and 93.7 octane regular gasoline will be needed by 1961 (compared with the present 92.8 premium and 85.3 regular).

The amount of catalytic reforming construction during 1953 was thought to be phenomenal, but a look at 1954 indicates even more. This year reforming capacity is expected to jump from 250,000 barrels daily capacity to 1,000,000 barrels daily either planned or in operation. For the first time, reforming is building more capacity than catalytic cracking.

The effect of reforming does not stop with the octane picture. The availability of hydrogen as a by-product from catalytic reforming opens up new process possibilities—hydrogen-finishing processes, petrochemical processing (ammonia, for example) and high-pressure hydrogenation.

The hydrogen-finishing or mild hydrogenation processes have their most important application in desulfurization at present. During the period 1940 to 1953, U. S. crude oil sulfur content has increased 127 percent, presenting a real challenge to product sulfur specifications. The finishing processes are also proving useful for improving feed stocks to cat crackers and reformers, boosting diesel fuel cetane ratings, raising lube stock viscosity index, and deodorizing solvents. Licensed processes now available include Unifining, Hydrofining and Hydrodesulfurization.

The use of this by-product hydrogen in ammonia synthesis saw its first installation this year at Atlantic Refining's Point Breeze refinery. Three more installations are planned by other companies. Unlike the hydrogen-finishing processes, this route requires that the hydrogen be purified first, a step which makes the operation uneconomical in many cases.

High-pressure hydrogenation is probably ten years away. Several factors deter this development. First, and most important, the amount of hydrogen required is very high on a per barrel basis. There actually will not be enough hydrogen available for this type of operation until even more catalytic reforming is installed. Second, there is no really good process available for high-pressure hydrogenation. In the present processes the costs for equipment are very high and the catalysts are only mediocre. Third, other methods are available for upgrading residual stocks—coking, vacuum distillation, and decarbonizing.

Other processes which are highly active in quality improvement programs include catalytic cracking, cracking feed preparation, and catalytic polymerization.

Process-wise the refiner has many choices as to how best to meet gasoline quality demands. Plant balances have become quite complex with all the blending stocks available. For a comprehensive look at typical stocks, we are presenting a 16-page article entitled "Gasoline Blending Stocks" starting on page 284. In this monograph you will be able to compare the susceptibilities and sensitivities of the usual refinery stocks and also the yield-octane relations for catalytic and thermal reforming.

Robert J. Phillips
EDITORIAL DIRECTOR

Internal **TRAFFIC CONTROL** in your **PROCESS VESSELS** with **YORKMESH DeMISTERS**

There's a green light for vapor and a stop for entrained liquid when Yorkmesh Demisters are on the job providing internal traffic control in your process vessels. Designed and constructed to effect clean separation between liquid and vapor, even at velocities which may be considered excessive, Yorkmesh Demisters improve the performance and increase the throughput capacity of vacuum towers, distillation equipment, scrubbers, gas absorbers, knock-out drums and other process vessels handling both liquid and vapor phase materials.

Easily installed in new or existing equipment these specially knitted fine wire mesh demisters provide highest efficiency at lowest cost, and are available in a wide range of corrosion resistant materials. To find out how Yorkmesh Demisters can improve the performance of your process vessels, write for Bulletin 16.

YORK

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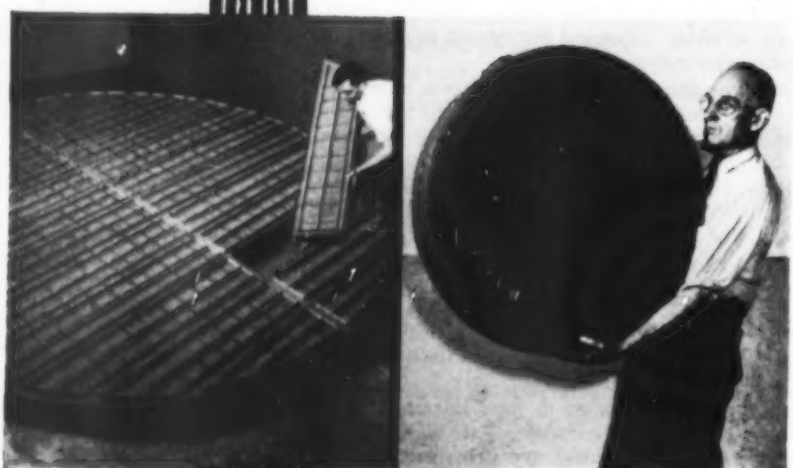

above left: sectional construction
above right: one piece construction

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Cyanamid Announces the first commercially-proved

HIGH ALUMINA CATALYST

Year's refinery experience demonstrates excellent selectivity, high activity stability and low stack losses with

Aerocat Triple A* High Alumina Catalyst

American Cyanamid Company has successfully developed a high alumina (25%) catalyst with selectivity equivalent to or better than that of regular alumina (13%) catalysts.

A year's trial in a commercial fluid unit has confirmed laboratory research that indicated superior cracking performance could be secured with a higher alumina catalyst. In this trial, AEROCAT TRIPLE A demonstrated several advantages:

Greater activity stability—it maintains a 15-25% higher equilibrium activity than 13% alumina catalyst, resulting in more efficient cracking operations.

Lower stack losses—this means more effective retention of fresh catalyst additions, and permits the withdrawal of a higher proportion of spent, heavy material from the cracking unit. The result is better fluidization and retention of a higher level of activity. High resistance to attrition is also indicated.

Excellent selectivity in a number of base stocks is also indicated by laboratory experience.

These results indicate that use of AEROCAT TRIPLE A will contribute to optimum performance in fluid cracking units, increasing volume of output per ton of catalyst used or giving improvement in performance at the same catalyst usage rate.

AEROCAT TRIPLE A Catalyst was developed by Cyanamid in cooperation with a major oil refiner. Samples are available for laboratory evaluation, and expansion of present production facilities will make additional commercial quantities available soon.

*Trade-mark

Aerocat Triple A* High Alumina Catalyst

AMERICAN *Cyanamid* COMPANY

Refinery Chemicals Department

30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

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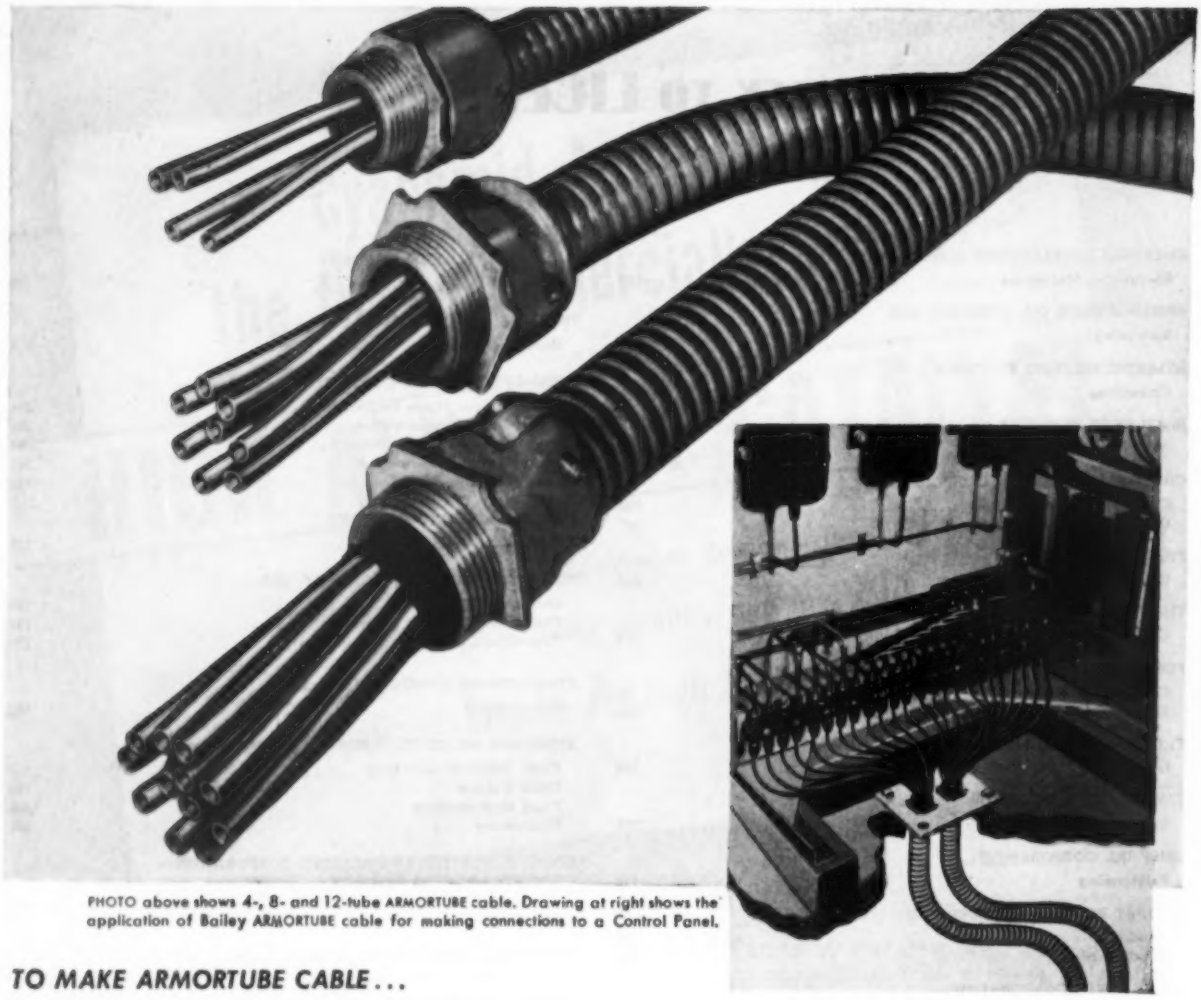

PHOTO above shows 4-, 8- and 12-tube ARMORTUBE cable. Drawing at right shows the application of Bailey ARMORTUBE cable for making connections to a Control Panel.

TO MAKE ARMORTUBE CABLE...

Bailey Meter Company turns to Anaconda for long lengths of ¼" O. D. copper tubes

Bailey Meter Co., Cleveland, Ohio, calls its ARMORTUBE Flexible Protected Tube Cable, "the modern shortcut to simpler, safer, more economical air and hydraulic circuits."

As shown above, this cable is available in bundles of four, eight or twelve ¼" O.D. copper tubes. A continuous, heavy galvanized steel strip protects the tube bundle.

Here's why Bailey turned to Anaconda as the logical source of supply for these ¼" O.D. copper tubes.

LONG LENGTHS

Because ARMORTUBE cable is shipped in random lengths of about 500 feet, Bailey needed long lengths of copper tube. Anaconda makes copper tube up to 2,400 feet long, depending on the diameter.

CLEAN INTERIORS

These tubes had to be free from dust, dirt or metal chips which might otherwise interfere with the operation of delicate air and hydraulic circuits. Anaconda takes special care to see that inside surfaces of ANACONDA Copper Tubes are clean, smooth and bright. Tube ends are sealed to keep out moisture and foreign matter during storage.

FLEXIBLE

Tubes had to be flexible enough to bend around corners and obstacles. ANACONDA Copper Tubes are uniformly soft . . . highly flexible. And they are accurate in size and shape.

ANACONDA Dehydrated Copper Tubes are made in all standard sizes up to and including ¾" O.D. Usually furnished in 25-, 50- and 100-foot coils, they are also available in longer lengths on spools and reels where required.

Our Technical Department will be happy to lend a hand on any problem involving the use of copper tubes. A letter outlining your problem will bring a prompt answer. Write to: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

54158

ANACONDA®

COPPER TUBES

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Fluid Catalytic Cracking—STANDARD OIL DEVELOPMENT COMPANY

Application—The Fluid Catalytic Cracking process has come into existence primarily because of its ability to produce greater yields of gasoline of a higher octane number than the thermal cracking process, which it has largely displaced.

Charge—Feed stocks range in commercial operation from naphtha cuts to heavy gas oils and deasphalted residuums.

Product—High yields of motor gasoline are obtained, with clear octane numbers of 81-83 ASTM and 92-99 CFR. By-products, such as isobutane and light olefins for alkylation, polymerization, LPG or for synthetic rubber ingredients are recovered.

Description—In the process finely divided catalyst is suspended in gas or vapor so that it flows through the equipment with flow characteristics resembling a liquid. Thus, it circulates continuously between reaction and regeneration zones. The heat from the regenerator is transferred to the reactor, thereby replacing the need for cooling surfaces in the regenerator and greatly reducing the preheat requirement for the feed.

The drawing is illustrative of a modern catalytic cracking unit. Gas oil is injected into the hot regenerated catalist line just before it enters the reactor. The catalyst rate is regulated to maintain the required temperature of reaction. Having entered the reactor, the catalyst begins to settle, forming a dense bed, which resembles a violently boiling liquid with a rather clearly defined level. Vapors leave the reactor through cyclone separators which return most of the entrained catalyst to the bed. Cracked products are then separated in conventional fractionation and absorption equipment.

In the reactor, the catalyst accumulates a carbonaceous deposit in the form of coke. After stripping, to remove any retained hydrocarbons, this spent catalyst is transferred to the regenerator by the injection of a stream of air into the transfer line below the regenerator. The major portion of the air is supplied to the regenerator directly to burn the coke from the catalyst. The heat of combustion is absorbed by the regenerated catalyst, which in its turn supplies it to the feed stock to effect vaporization. Regenerated catalyst is supplied to the reactor through the other transfer line under its own pressure head.

Since the first fluid catalytic cracking unit was installed 12 years ago, the process has been continuously simplified and improved. The Model IV unit, which is shown in the accompanying drawing, incorporates the most recent engineering modifications designed by Standard Oil Development Company. A new and unique patented catalyst circulation system and other changes have made sharp reductions in the over-all size and height of the catalytic cracking unit, with a resulting lowering of investment and maintenance costs. A Model IV unit is 70 percent as high as its immediate predecessor. Reductions in the order of 20 percent in investment cost and corresponding lowering of steel requirements result.

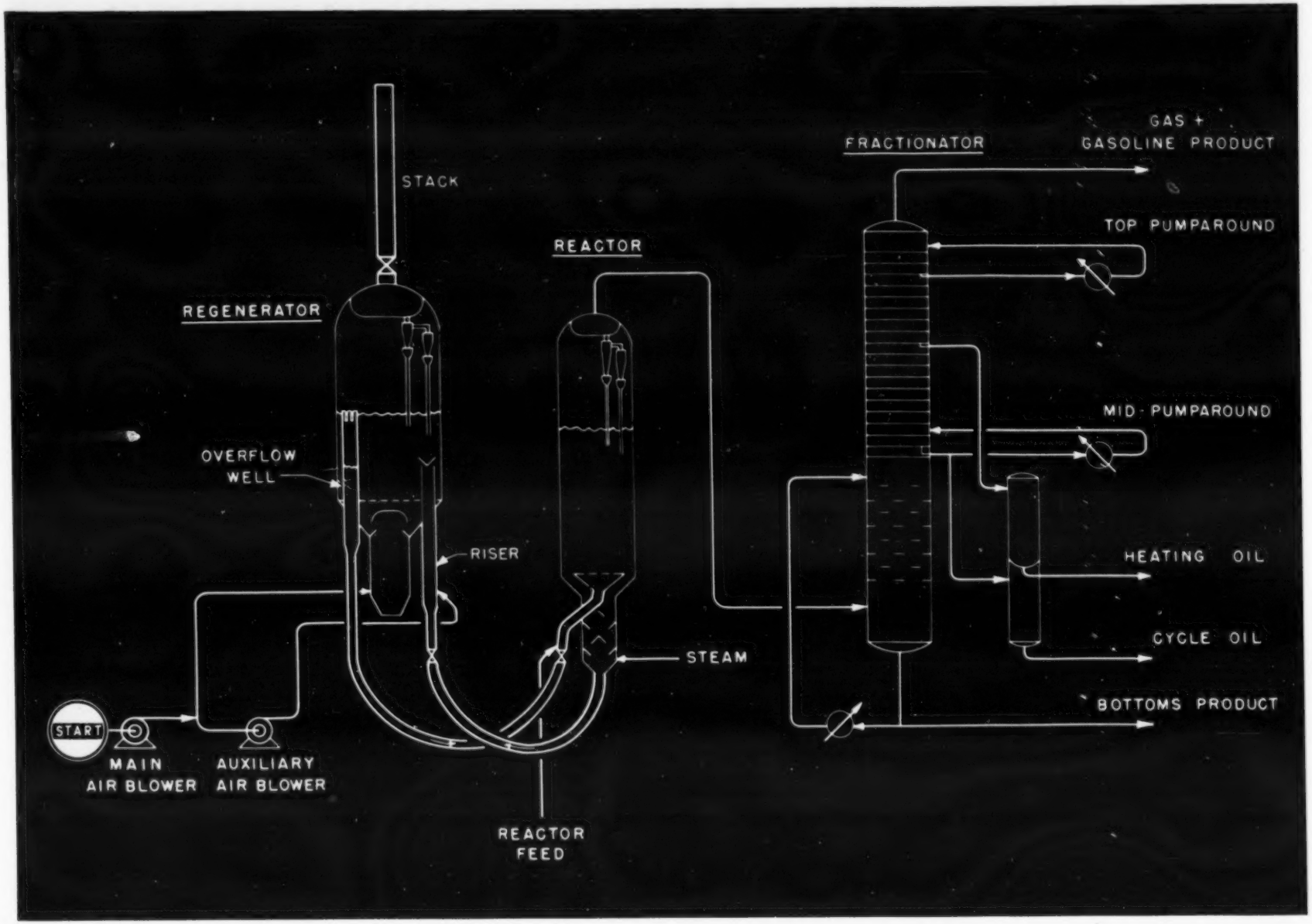
Recycle operations have been found attractive in many cases. The flexibility of the process has been demonstrated through uninterrupted runs of three years, and by general high service factor levels. High catalyst recovery has been established in commercial plants, based on a circulation rate corresponding to a loss averaging about 0.25 pounds per barrels of feed.

Commercial Installations—It is estimated that by the end of 1954 there will be about 2,900,000 barrels per stream day (total feed) Fluid Catalytic cracking capacity throughout the world, 2,300,000 barrels per day of this being in the United States. There are 155 units built, building, or contracted. In the case of the Model IV unit, installations now operating, under construction, or planned represent an operating capacity of about 380,000 barrels per stream day. Some details on these Model IV units are shown listed:

Model IV Fluid Catalytic Cracking Units
(Constructed, Building, and Approved)

COMPANY	Location	Capacity Total Feed B D	Date on Stream	Builder
Imperial Oil, Ltd.	Edmonton, Alberta	11,000	December '52	Foster Wheeler
Imperial Oil, Ltd.	Sarnia, Ontario	25,000	March '53	M. W. Kellogg
Esso Std. Soc. An. Fr.*	Port Jerome, France	15,400	July '53	Foster Wheeler
Esso Std. Ref. Soc. An.*	Antwerp, Belgium	9,360	July '53	Lummus
Esso Std. Oil Company*	Everett, Massachusetts	24,000	July '53	Foster Wheeler
Imperial Oil, Ltd.	Ioco, B. C.	12,600	November '53	Bechtel
Esso A. G.*	Hamburg, Germany	9,360	December '53	Gutehoffnungshuette A. G.
Std.-Vacuum Oil Company*	Durban, South Africa	9,740	January '54	Foster Wheeler
Imperial Oil, Ltd.	Regina, Saskatchewan	13,600	May '54	Fluor
Std.-Vacuum Oil Company*	Bombay, India	9,360	July '54	Lummus
Imperial Oil, Ltd.	Halifax, Nova Scotia	27,000	( )	
Total for Standard Oil Company (New Jersey) Affiliates		166,420		
Pan-American Southern Corp.	Destrehan, Louisiana	15,000	November '52	Lummus
Cie Francaise de Ref.*	LaMede, France	14,740	July '53	Lummus
International Ref. Inc.*	Wrenshall, Minnesota	4,880	August '53	Lummus
Lion Oil Company	El Dorado, Arkansas	10,800	December '53	Lummus
Pan American Ref. Corp.	Texas City, Texas	30,000	January '54	Lummus
Empresa Col. de Pet.	Barrancabermeja, Col.	19,280	(August '54)	Foster Wheeler
Std. Oil Co. of Calif.	El Segundo, California	55,000	(August '54)	Fluor
Calif. Texas Oil Co., Ltd.	Batangas, P. I.	10,800	(October '54	Foster Wheeler
Calif. Texas Oil Co., Ltd.	Yokohama, Japan	10,800	(November '54)	Arthur G. McKee
Std. Oil Co. of B. C., Ltd.	Vancouver, B. C.	6,000	(November '54)	Fluor
Calif. Texas Oil Co., Ltd.	Kurnell, Australia	30,000	(June '55)	Foster Wheeler
Std. Oil Co. of Calif.	Salt Lake City, Utah	8,000	(June '56)	Fluor
Total Non-Jersey		215,300		
Total		381,720		

* Combination Unit.


STACK
REACTOR
FRACTIONATOR
GAS +
GASOLINE PRODUCT
TOP PUMPAROUND
REGENERATOR
MID-PUMPAROUND
OVERFLOW
WELL
RISER
HEATING OIL
CYCLE OIL
STEAM
START
BOTTOMS PRODUCT
MAIN
AIR BLOWER
AUXILIARY
AIR BLOWER
REACTOR
FEED

Fluid Catalytic Cracking—UNIVERSAL OIL PRODUCTS COMPANY

Application—The UOP Fluid Catalytic Cracking process is a high-temperature and low-pressure catalytic cracking process employing the fluid technique to circulate catalyst. It is employed primarily to convert distillate oils into high octane gasoline and to reduce the overall refinery fuel oil production. The process has undergone continued development since its first introduction, and current designs are noted for their simplicity, and ease of operation as well as low operating and investment costs, with optimum product distribution.

Charge—This process may be used for the cracking of a wide variety of stocks from all types of crude sources. Typical stocks may be either virgin or cracked and may include naphtha, kerosine, light gas oils, wax distillates, atmospheric and vacuum heavy gas oils, and distillates from viscosity breaking or coking.

The heaviest distillates are excellent charging stocks. The only limitations are Conradson carbon and metal contaminants content. The effect of increased Conradson carbon is to form increased catalyst deposit. Thus if the burning capacity of the regenerator is not limiting, 0.5 to 0.75 per cent Conradson carbon values or higher may be tolerated, but normally the figure is not expected to exceed 0.25 percent. The Conradson carbon increases as the vacuum bottoms are further reduced to supply heavier vacuum gas oil charging stock. Normally when producing vacuum bottoms of 100 penetration, the vacuum gas oil overhead from the vacuum distillation column is a permissable feed stock.

Description—A typical flow diagram for a 5000 barrels per stream day unit is shown on the following page.

The gas oil feed, cold or hot, is charged together with recycle into the hot regenerated catalyst stream, is vaporized, and passes to the reactor. Vapors from the reactor, carrying some catalyst, pass upward through the reactor cyclone separator, which removes most of the entrained catalyst, and into the fractionating column.

The spent, or used, catalyst passes downward from the reactor through the steam stripper and enters the regenerator where the carbon deposit is burned therefrom. Oxygen for combustion is supplied by air from the air blower. The flue gases carrying some catalyst pass upward through the regenerator cyclone separators where entrained catalyst is removed, and pressure is released in a pressure reducing chamber which serves as a noise eliminator. The regenerated catalyst again enters the incoming gas oil charge stream to repeat the cycle.

For a typical unit of this capacity, the "single vessel" type (reactor superimposed upon the regenerator) is used.

No external heater is necessary with this unit since it is of the heat balance type. The initial heat to bring the unit on stream is supplied by a direct-fired air preheater and torch oil in the regenerator.

The fractionating column is, in general, conventional, with gasoline taken overhead and one or more selected fractions withdrawn as sidecuts. The net column bottoms are sent to storage via the slurry settler. Steam may be generated by recovery of heat in the fractionator column bottoms. Catalyst-containing oil from the bottom of the slurry settler is returned to the reactor with the fresh feed.

The unstabilized gasoline and gas pass to a gas fractionation section for debutanization an drecovery of C_3—C'_4 polymerization unit feed.

The fresh feed capacity of a catalytic cracker, in general, depends upon the conversion, combined feed ratio, and the coke burning capacity of the regenerator.

The total catalyst inventory of a 5000-barrel-per-stream-day unit, burning around 4233 pounds per hour of coke, at 53 percent conversion, is about 37 long tons.

The UOP regenerator design is set up for optimum pressure to increase the coke burning rate (pounds of coke burned per hour per pound of catalyst inventory in the regenerator) and the regenerator is therefore, reduced in size, which reduction in turn reduces the catalyst inventory in the unit. Thus catalyst replacement rate expressed in pounds/barrel required to maintain a given catalyst activity is low.

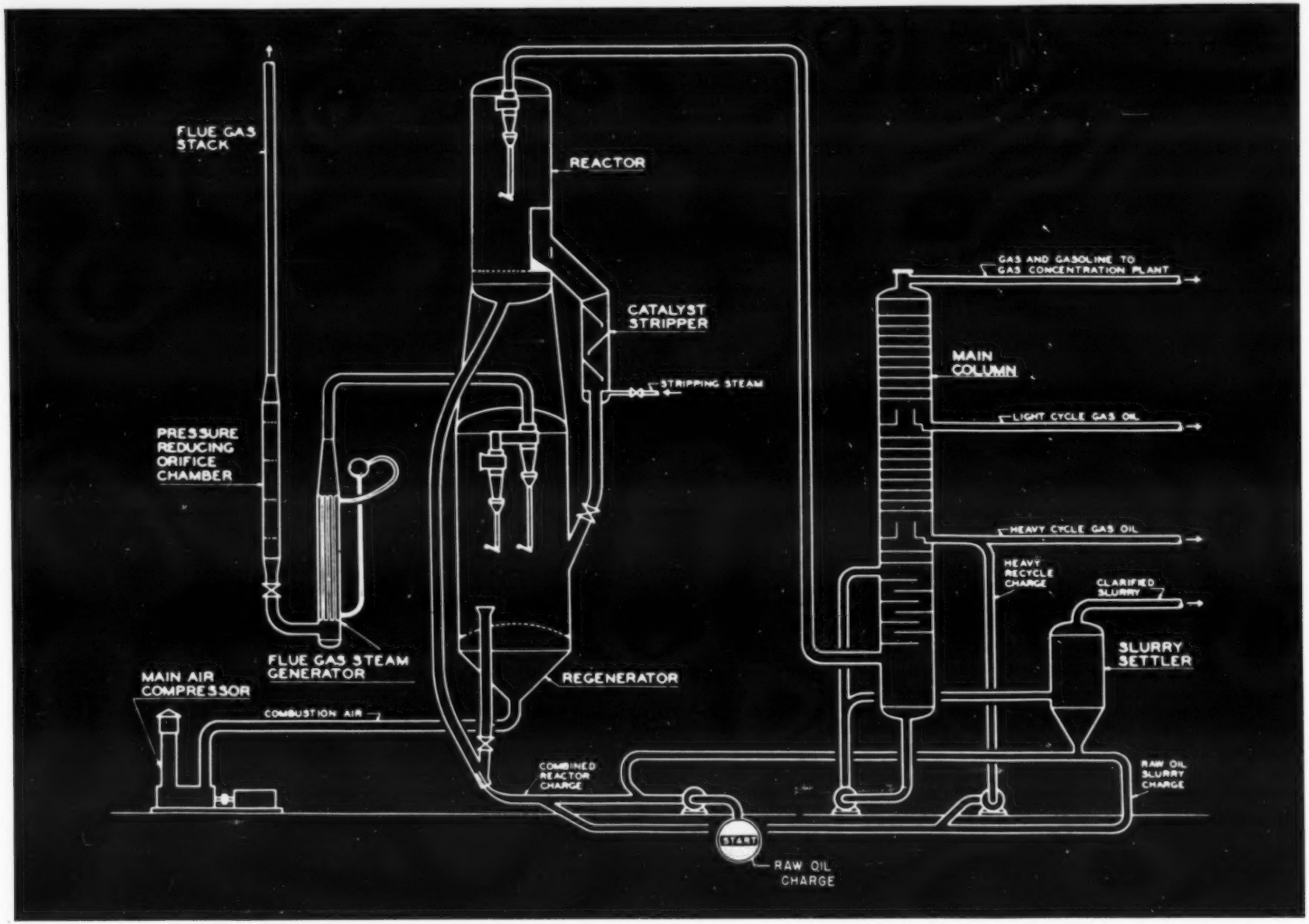
With the proper velocity in the regenerator, a small catalyst inventory, and two-stage cyclone separators of the proper design, the catalyst loss at 53 percent conversion will not exceed 0.25 pounds per barrel of fresh feed and for 70 percent conversion will not exceed 0.40 pounds per barrel.

This rate of catalyst makeup is usually about that required to maintain the catalyst activity and is normally within specifications set forth by any local laws.

Yields—Typical yields from a UOP Fluid Catalytic Cracking unit when cracking a 28° API Mid-Continent gas oil, over silica-alumina catalyst, in once-through and recycle operation, are as follows:

OPERATION	Once Through	Recycle
Conversion	60	75
Yields, (Volume Percent)		
Debutanized Gasoline	45.2	53.5
Light Cycle Oil	28	21
Heavy Cycle Oil	12	4
Butylenes	5.9	8
Butanes	6.4	8
Propylene	5.0	6.4
Propane	2.9	3.7
C_2 and Lighter Gas, Weight Percent	2.2	2.8
Octanes, 10 Lb. RVP Gasoline		
Motor Method (F-2) Clear	81.5	81.5
3 cc TEL	86.5	86.5
Research Method (F-1) Clear	93.5	93.5
3 cc TEL	98.5	98.5
Yields With Polymerization (Volume Percent):		
10 Lb. RVP Polymer Gasoline	7.6	10.0
10 Lb. RVP Catalytic Cracked Gasoline	47.6	56.4
Total 10 Lb. RVP Gasoline	55.2	66.4

Commercial Installations—There are at present 50 UOP Fluid Catalytic Cracking units in operation, and nearly a dozen more in various stages of design or construction. All of these represent a total design feed capacity of more than 400,000 barrels per day. Sizes of the units range from 1400 to approximately 35,000 barrels per stream day fresh charge.


FLUE GAS STACK
REACTOR
CATALYST STRIPPER
STRIPPING STEAM
GAS AND GASOLINE TO GAS CONCENTRATION PLANT
MAIN COLUMN
LIGHT CYCLE GAS OIL
PRESSURE REDUCING ORIFICE CHAMBER
HEAVY CYCLE GAS OIL
HEAVY RECYCLE CHARGE
CLARIFIED SLURRY
SLURRY SETTLER
FLUE GAS STEAM GENERATOR
REGENERATOR
MAIN AIR COMPRESSOR
COMBUSTION AIR
COMBINED REACTOR CHARGE
RAW OIL SLURRY CHARGE
START
RAW OIL CHARGE

Houdriflow—HOUDRY PROCESS CORPORATION

Application—The Houdriflow catalytic cracking process is employed commercially to process all petroleum distillate fractions of all boiling ranges for the production of high octane motor and aviation fuels.

Charge—A wide variety of petroleum distillate stocks can be catalytically cracked in Houdriflow operations. Sweet and sour stocks, representing fractions of crudes boiling between naphtha and penetration asphalt, are handled equally well. If desired, straight-run and cracked gasolines may be processed along with gas oil cracking for sulfur removal and quality improvement.

Products—Motor gasolines from Houdriflow cracking have octane values in the range of 88-94 F-1 Clear and 95-99 F-1 + 3cc TEL depending upon the temperature level, the type of charging stock and catalyst. In addition to gasoline, the C_3 and C_4 light products are rich in unsaturates and may be further processed for the production of alkylate or polymer gasoline, or used in the petrochemical industry. A large percentage of the catalytic gas oil is light in boiling range and suitable for blending to No. 2 fuel. In many cases a portion of the catalytic gas oils can be blended into diesel fuels. Due to its low viscosity the small quantity of heavy catalytic gas oil produced is readily utilized as residual cutter stock.

Description—The oil flow as shown in the diagram is as follows: Vapor or liquid charging stocks or mixtures of the two flow through a common oil feed nozzle into the reactor. Commercial Houdriflow units have operated with 100 volume percent of the feed in liquid phase.

After cracking, the reactor vapors are separated from the catalyst in a disengager and flow to the synthetic crude tower. The catalyst is next purged with low pressure steam in a short purge section to remove residual oil remaining on the catalyst. The vaporized residual oil joins the main stream of cracked vapors and flows to the fractionating column. Houdriflow's efficient purge system results in higher liquid recovery and less burning load in the kiln.

For the catalyst flow, regenerated catalyst flows by gravity from the lift disengager through the top seal leg, reactor, purge section, intermediate seal section, kiln and transfer line to the bottom of the gas lift system. Steam flows through the top seal leg counter-current to the catalyst as an inert sealing medium to prevent the escape of hydrocarbon vapors via this route.

Approximately 75 percent of the catalyst entering the reactor flows down through a center pipe in the reactor inner head and is admitted to the cracking zone through an annular orifice which surrounds the hydrocarbon feed nozzle.

The portion of the catalyst that does not flow through the center annulus enters the cracking zone through a circle of pipes located near the periphery of the vessel. These pipes serve to maintain the top of the catalyst bed at the desired level, thereby setting the space velocity.

From the reactor purge section, the catalyst flows next through the intermediate seal section, and enters the kiln where the coke deposit is removed by combustion with a counter-current flow of air. Most of the heat liberated by combustion of the coke is absorbed by the catalyst and utilized in the reactor, but any excess is extracted from the catalyst and is recovered, in the form of steam, by means of transverse cooling coils.

After flowing through the kiln the catalyst is collected by means of an arrangement of concentric cones fed by equally spaced pipes into a single outlet line through which it flows to the lift engager. A mixture of flue gas and steam from the thermocompressor lifts the catalyst to the top of the unit, thereby completing the catalyst flow cycle.

Air is supplied to the kiln from a single stage centrifugal blower which discharges at about 4.0 psig pressure. The air stream enters the kiln at the bottom of each burning zone and flows upwardly counter-current to the catalyst through the burning zone. An air heater is provided for start-up and as a means of temperature control during operation if desired.

Some of the flue gas from the lower zone is compressed in the jets by high-pressure steam (100 psig) to a pressure of about 6 psig to serve as the catalyst lifting medium. Another part of the flue gas is used for elutriation and the remainder is discharged through the stack to the atmosphere.

Operating Conditions—The major process variables are temperature, catalyst/oil ratio, and space velocity. Regulation of these variables, along with the extent of internal recycling, makes the cracking process extremely flexible with respect to product distribution and quality. Normal operating conditions fall in the range of 850 to 925 F. temperature, 5 to 10 psig pressure, 1.5 to 4 w/hr/w space velocity and 3 to 7 w/w catalyst/oil ratio.

Yields—In some Houdriflow units, above 90 percent conversion is achieved using recycle to fresh feed ratios of 1/1 or slightly more; while elsewhere once-through cracking is preferred at 50 to 60 volume percent conversion.

Typical yields for four commercial installations:

PLANT	Sun	Tide Water	Salt Lake	Shamrock
Charge:				
Fresh Gas Oil, BPSD	3,790	4,460	10,165	4,750
Cat. Cycle Oil, BPSD	1,060			
Internal Recycle BPSD	2,280	2,200	2,520	5,700
Total Reactor Charge, BPSD	7,130	6,660	12,685	10,450
YIELDS (Fresh Charge Basis):				
Dry Gas, Weight Percent	7.5	5.8	6.1	5.4
C_3 Fraction, Volume Percent	....	....	....	13.1
C_3-C_4 Fraction, Volume Percent	....	20.1	....	....
C_4 Fraction, Volume Percent	13.3	....	14.9	19.0
Gasoline, Volume Percent	46.2	52.2	45.4	64.2
Light Cycle Oil, Volume Percent	37.8*	19.8	20.3	2.2
Heavy Cycle Oil, Volume Percent	....	11.3	20.0	7.0
Coke, Weight Percent	5.2	5.4	2.8	9.0
Conversion, Volume Percent	62.2	68.9	59.7	90.8
Liquid Recovery, Volume Percent	97.3	103.4	100.6	105.5
Inspections:				
Debutanized Gasoline				
F-1 Clear Octane	90.0	90.5	90.4	88.5
Charge				
Gravity, °API	28.5	28.6	25.4	32.0
Vacuum Distillation °F:				
10 Percent	558	600	....	....
50 Percent	679	755	784	780
90 Percent	882	845	....	....
End Point	....	995	968	1075+

* Total Cycle Oil.

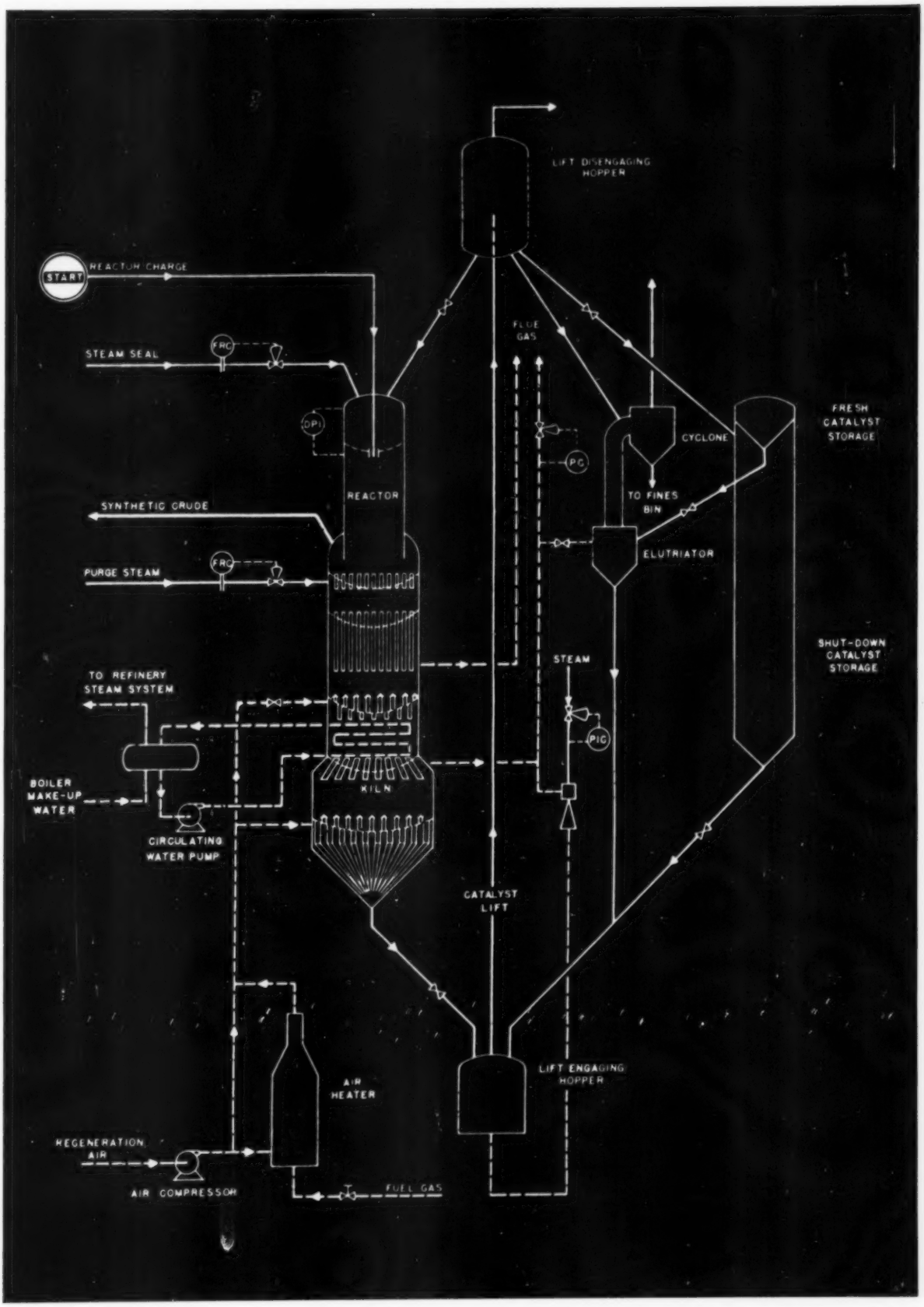
Commercial Installations—Presently there are a total of 14 Houdriflow units in operation as follows:

Company	Location	Design Charge Capacity BPSD
Tide Water Associated Oil Co.	Drumright, Okla.	6,750
Sun Oil Company	Toledo, Ohio	30,000*
Clark Refining Corporation	Blue Island, Ill.	5,000
Salt Lake Refining Company	Salt Lake City	13,000
The California Oil Company	Barber, N. J.	25,000**
Shamrock Oil & Gas Corporation	Sunray, Texas	11,000
Standard Oil Co. of Texas	El Paso, Texas	11,500
Texas City Refining Company	Texas City, Texas	18,730
Gewerkschaft Erdol Raffinerie Emsland	Lingen, Germany	17,500
Sun Oil Company	Sarnia, Ontario	11,500

*Four units. ** Two units.

In addition the following five units are being constructed and engineered in the U. S. and abroad:

Albatros S. A. Belge pour le Raffinage de Petrole	Antwerp, Belgium	3,650
Daikyo Oil Company	Yokkaichi, Japan	4,200
Canadian Petrofina Ltd.	Montreal, Quebec	16,000
Sun Oil Company	Marcus Hook, Pa.	27,000
Sun Oil Company	Toledo, Ohio	24,000
Commonwealth Oil Refining Company	Puerto Rico	26,800


LIFT DISENGAGING HOPPER
START
REACTOR CHARGE
STEAM SEAL
FRC
FLUE GAS
DPI
REACTOR
PC
CYCLONE
FRESH CATALYST STORAGE
SYNTHETIC CRUDE
TO FINES BIN
ELUTRIATOR
PURGE STEAM
FRC
SHUT-DOWN CATALYST STORAGE
STEAM
TO REFINERY STEAM SYSTEM
PIC
KILN
BOILER MAKE-UP WATER
CIRCULATING WATER PUMP
CATALYST LIFT
LIFT ENGAGING HOPPER
AIR HEATER
REGENERATION AIR
AIR COMPRESSOR
FUEL GAS

Orthoflow—THE M. W. KELLOGG COMPANY

Application—The Orthoflow design is a new model Fluid catalytic cracker for the production of high octane gasoline at low investment. Two modifications of the design have been developed and proved in commercial installations. Both feature upright, single vessel construction.

In the Orthoflow converters, Model A, the reactor is positioned atop the regenerator. In the Model B, further refinements and improvements in the Orthoflow principle have been obtained by reversing the positions, placing the reactor on the bottom and the regenerator above. Among the advantages gained in the new design are a decrease in the size of the reactor and fractionator, and reduction of utilities requirements for both gas compression and compression of regneration air.

Charge—Feed stocks consist of a wide range of gas oils from either atmospheric or vacuum distillation or from other feed preparation units such as solvent decarbonizing, visbreaking or Delayed Coking.

Product—High octane gasoline can be made in a wide range of yields and of varying characteristics. A high grade of heating oil can also be made as a by-product of the cracking reaction.

Description—A simplified flow chart for the Model "B" Orthoflow Fluid catalytic cracker is shown on the opposite page.

Fresh gas oil feed and recycle return from the fractionator enter the base of the reactor through a number of injection points to provide adequate distribution. Regenerated catalyst flows downward through standpipes, contacts the oil vapors, and is carried up into the reaction zone in sufficient quantity to maintain the reaction temperature. A catalyst bed level is established in the reactor to give the required space velocity. The oil vapors from the cracking reaction are separated from entrained catalyst in internal cyclones and carried to the fractionator.

The spent catalyst stripping zone is positioned centrally within the reactor vessel, and stripped spent catalyst is conveyed upward to the regenerator vessel with a portion of the regeneration air which is admitted through the hollow stem of the spent catalyst plug valve. In the regenerator, the spent catalyst is contacted with additional air to reduce the carbon content to the desired level. Internal cyclones are used to separate regenerated catalyst from the flue gas stream exiting from the top of the regenerator.

In the fractionator, the product stream is separated into gasoline, light gas oil, a recycle stream, and a slurry stream. The recovery and finished gasoline plant consists of absorption and stabilization units to produce a high grade of gasoline. A highly olefinic feed stock suitable for catalytic polymerization can be obtained from the gas recovery unit if desired.

By the construction of the reactor and the regenerator in a single converter vessel and the use of straight internal catalyst carrier lines, the unit represents the simplest design to date. One of the major design achievements was the development of the plug valves which regulate internal catalyst flow. These valves eliminate the need for expansion joints in certain designs and are much more easily maintained than conventional slide valves. Although the plugs of the valves are subjected to the same erosive action of the catalyst as slide valves, the operating history of Orthoflow units has been remarkably free of erosion difficulties. The rate of erosion of the plugs is considerably less than in slide valves, and unlike slide valves where erosion results in loss of control over catalyst flow, plugs can erode without appreciably affecting operability. The plug valve assemblies are bolted in for easy replacement when required.

Operating Conditions—See Table 1 at bottom of this page.

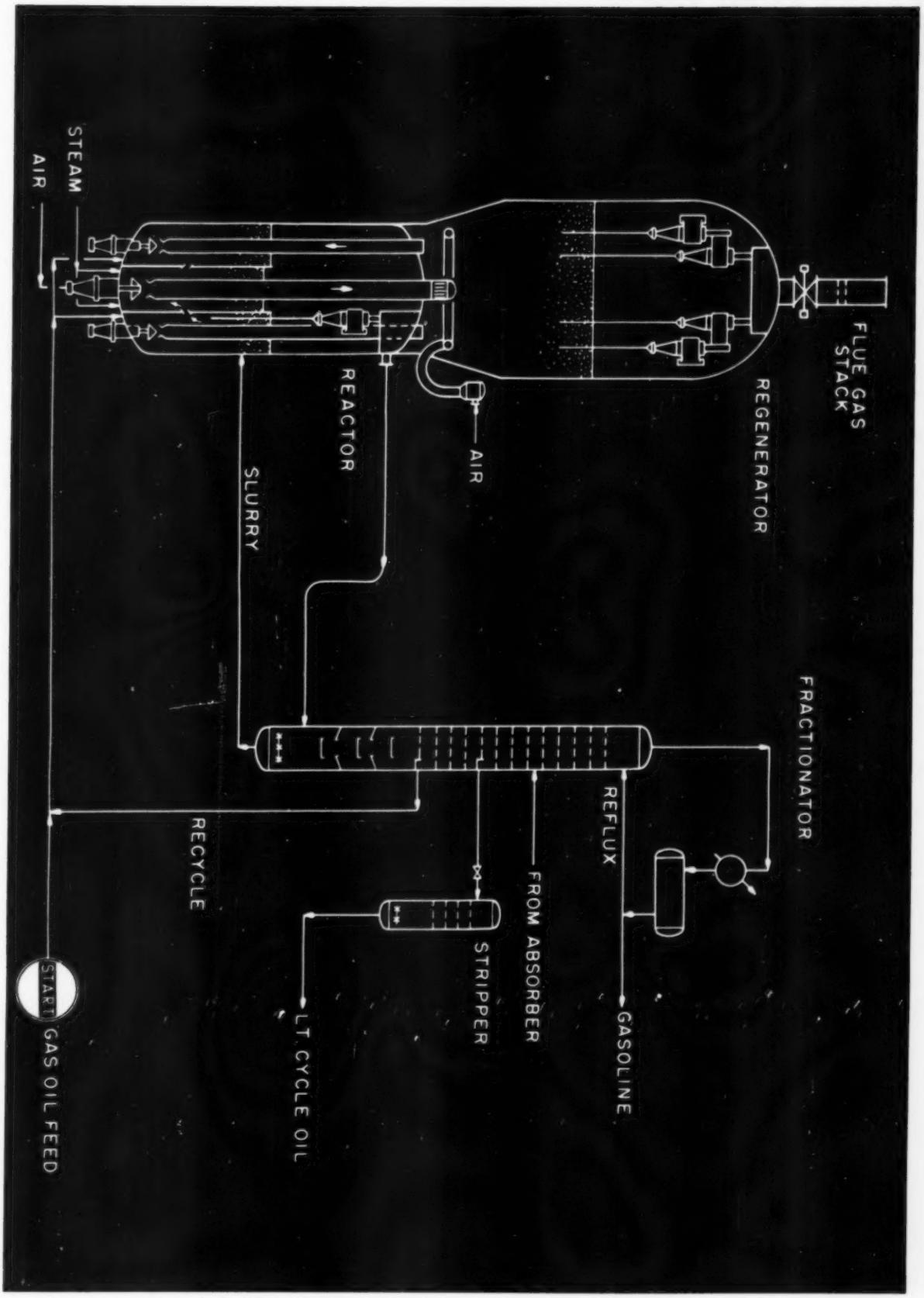
Yields—Typical yields from a Model "B" Orthoflow unit now in operation have run as follows:

Fresh feed rate	14,000 bpd
Total reactor thruput	22,000 bpd
Debutanized gasoline	48 vol. %
Octane No., CFRR clear	92.2
Coke burning rate	15,500 lbs./hr.

Commercial Installations—A total of thirteen units of the Orthoflow design are operating or are underway at the present time. Of these, seven are of the Model B type, three of which are completed and in operation. The largest unit to date is a Model B currently being engineered for a total thruput capacity of 86,000 bpd.

TABLE 1

	Conventional Side-By-Side Unit	Model "B" Orthoflow
Reactor Temperature	885-950 F.	885-950 F.
Reactor Pressure	10-12 psig	14-16 psig
Regenerator Temperature	1050-110 F.	1050-1100 F.
Regenerator Pressure	8-10 psig	8-10 psig
Catalyst/Oil Ratio	8-12 C/O	8-12 C/O
Space Velocity	1.0-3.0 W/Hr/W	1.0-3.0 W/Hr/W


STEAM
AIR
REACTOR
SLURRY
AIR
REGENERATOR
FLUE GAS STACK
FRACTIONATOR
REFLUX
GASOLINE
FROM ABSORBER
STRIPPER
LT. CYCLE OIL
RECYCLE
STARTUP
GAS OIL FEED

Socony Airlift TCC—SOCONY-VACUUM OIL COMPANY, INC.

Application—Socony Airlift TCC units are used to process various fractions of crude oil to (1) produce high quality gasoline, (2) increase the yield of distillate fuel fractions, and (3) reduce the yield of residual fuels.

An improvement in the design of the Airlift TCC units which has been put into commercial operation during the past year permits a substantial reduction in the cost of these units for any given job.

Charge—The charge stocks are obtained from all types of crudes, and consist of virgin or previously processed petroleum fractions varying from the heaviest gas oil fractions to full boiling range deasphalted crude.

Products—The major product is usually considered to be gasoline, used as a high quality component of the refinery motor gasoline production. Other usual products include fuel gas, charge stocks for alkylation and catalytic polymerization, LPG, butane for gasoline pressuring, number two fuel oil base stock, cutter stock for heavy fuel, and (depending on the process scheme) high pressure steam for refinery use.

Description of Process—The Socony Airlift TCC unit is a simplification of the original TCC process introduced commercially ten years ago. Investments have been reduced while operating ease and flexibility have been increased by superimposing the reactor over the simplified kiln, and replacing the bucket elevators with a catalyst airlift. Referring to the accompanying flow diagram of the usual processing arrangement, the charge is first heat exchanged against fractionator streams, combined with recycle (if any), heated and flashed in a tar separator. The overhead vapors flow to the reactor, and the bottoms are fed to a small vacuum jug for further recovery of very heavy gas oil as liquid feed, which is introduced in the top of the reactor. The asphaltic bottoms may be used in residual fuel, coked, or visbroken. Alternate types of feed preparation systems may be employed, such as visbreaking, coking, propane deasphalting and the like.

In the catalytic section, regenerated catalyst flows by gravity slowly down the seal leg from the surge hopper to the reactor. Sealing steam or flue gas flows countercurrently upwards, thereby permitting the pressure to increase from atmospheric in the surge hopper to 7 to 15 psig in the reactor. In the reactor catalyst flows slowly by gravity through a reaction bed of uniform depth, past vapor collecting grids, through a purge zone, and out of the reactor. The purged spent catalyst from the bottom of the reactor flows slowly by gravity into the top of the kiln, and then through the kiln where it first contacts flue gas of low oxygen content in the upper (countercurrent flow) section. As the catalyst passes downward, in the kiln, its temperature is raised by the combustion of the coke, and then reduced by the incoming cold air. In the lower section of the kiln, the air and catalyst flow concurrently downward, with the temperature again increasing until the maximum temperature is attained just above the cooling coils. These coils remove excess heat of coke combustion by generating steam, and are controlled to cool the catalyst to the desired temperature for return to the cracking reaction. The regenerated catalyst flows slowly downward by gravity from the bottom of the kiln into the lift pot, where it is picked up by low-pressure air (introduced at about 2 psig) and lifted to the surge hopper at the top of the unit. The catalyst is separated from the lift air in the surge hopper, and flows slowly by gravity down the seal leg to complete the cycle.

The effluent vapors from the reactor flow to conventional fractionating and gas recovery systems to separate the cuts desired for blending into final refinery products. It is to be noted that TCC reactor effluent contains essentially no inert gases that would increase recovery problems. The Socony Airlift TCC unit has been designed around Socony bead catalyst, but can be and is operated with other types of catalyst of discrete particle size. The improved design maintains high catalyst activity with the low make-up rates required by attrition. The Socony Airlift TCC units in operation with Socony bead catalyst have an average make-up rate equivalent to about 0.3 pound per barrel of feed and a CAT-A index of 30.

Operating Conditions—Although usually designed for specific conditions for cracking a given feed stock, the Socony Airlift TCC unit has a wide range of flexibility in operating conditions. The major variables and their usual range include the following:

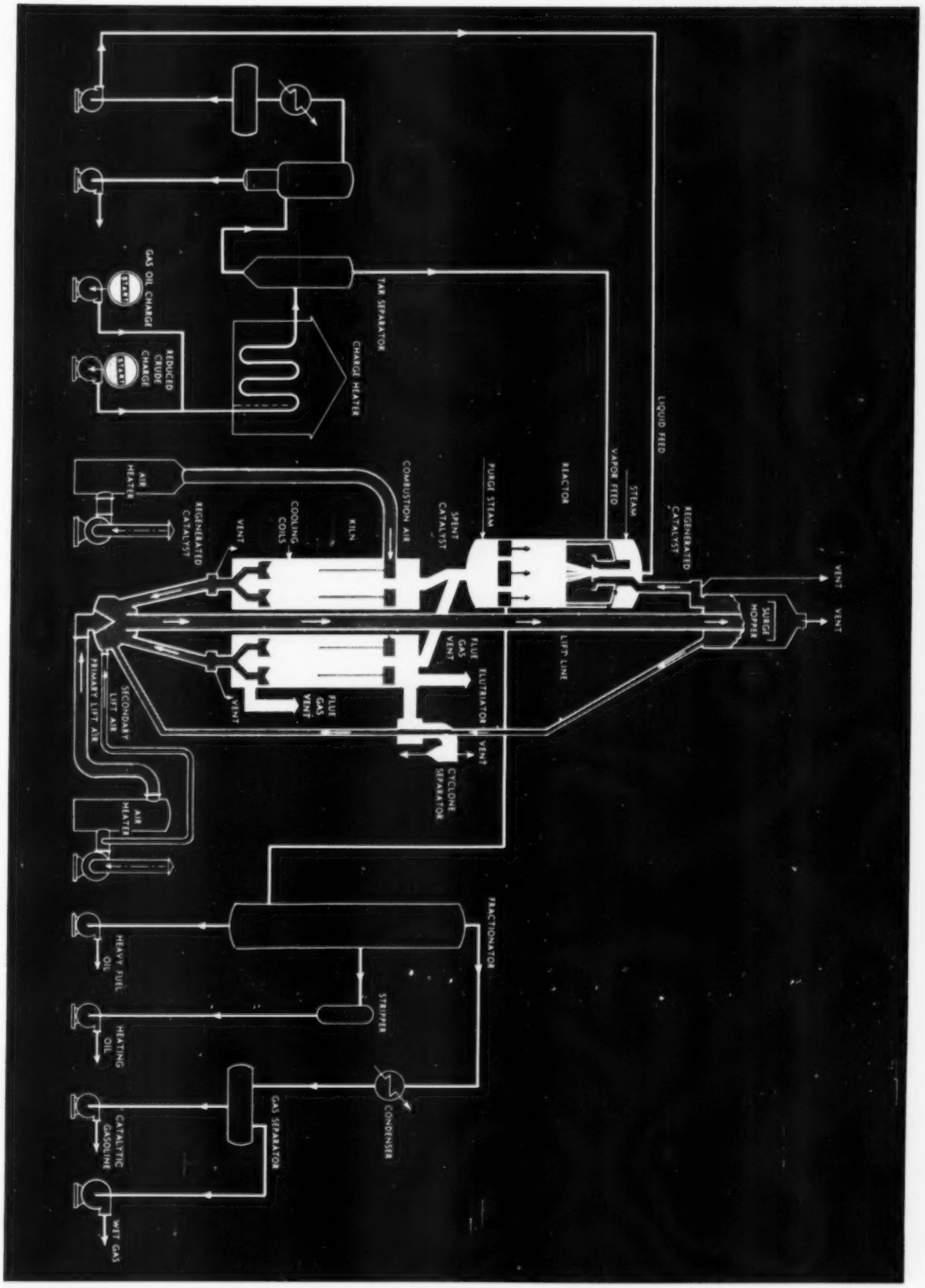
(1) Space Velocity—1 to 2.5 volumes of oil per volume of catalyst in the reaction zone (V/Hr/V).
(2) Catalyst-to-Oil Ratio—2 to 5 volumes of catalyst per volume of oil (V/V).
(3) Average Reactor Temperature—840 to 920 F.
(4) Catalyst Activity—25 to 34 CAT-A Index.
(5) Recycle to Fresh Feed—0 to 2 volumes of recycle per volume of fresh feed.

Yields—Typical commercial operating data are tabulated below, taken from a run charging Kansas gas oil boiling between diesel fuel and 135 F. softening point asphalt:

YIELDS		PROPERTIES	
Gasoline	56.3% Vol.	Charge Stock	26.5 °API
600 °F. E.P. Cycle Stock	15.0% Vol.		657 °F. at 10%
Heavy Cycle Stock	17.0% Vol.		835 °F. at 50%
Excess Butanes	5.1% Vol.		1021 °F. at 90%
Butylenes	5.7% Vol.	Gasoline	10.5 RVP
Propane	3.1% Vol.		137 °F. at 10%
Propylene	5.7% Vol.		230 °F. at 50%
			395 °F. at 90%
Total	107.9% Vol.	Octanes	90.6 Research Clear
C_2 and lighter gas	2.3% Wt.		97.2 Research plus 3cc TEL
Coke	5.2% Wt.		

Commercial Installations—The first Socony Airlift TCC unit went on stream October 6, 1950 at Beaumont, Texas. The following 32 units are in operation now, and 17 additional units are under construction. These units have capacities ranging from 1500 to 20,000 barrels per stream day.

Company	Location	No. of Units
American Liberty Oil Co.	Mt. Pleasant, Texas	1
Condor S.p.A.	Milan, Italy	1
Continental Oil Co.	Lake Charles, La.	2
Deutsche Erdol A.G.	Heide, Germany	1
Deutsche Vacuum Oel, A.G.	Bremen, Germany	1
Derby Oil Co.	Wichita, Kas.	1
Gelsenberg Benzin A.G.	Gelsenkirchen, Germany	1
Magnolia Petroleum Co.	Beaumont, Texas	3
MFA Oil Co., Inc.	Memphis, Tenn.	1
New Mexico Asphalt & Refining Co.	Artesia, N. M.	1
Permolio, S.p.A.	Genoa and Rome, Italy	2
Phillips Petroleum Co.	Okmulgee, Okla., and Woods Cross Utah	2
Raffineries Francaises de Petrole de l'Atlantique	Donges, France	1
SACOR	Lisbon, Portugal	1
Societe Cherifienne des Petroles, S.A.	Petitjean, Morocco	1
Socony-Vacuum Oil Co., Inc.	Illinois, Kansas, Michigan, New Jersey, New York	6
Socony-Vacuum Francaise	Frontignan, France	1
Standard Oil Co. (Ohio)	Cleveland, Ohio	2
Taylor Oil and Gas Co.	Corpus Christi, Texas	1
Vacuum Oil Co., Ltd.	Coryton, England	1
Vickers Petroleum Co., Inc.	Potwin, Kas.	1


GAS OIL CHARGE
REDUCED CRUDE CHARGE
TAR SEPARATOR
CHARGE HEATER
LIQUID FEED
REGENERATED CATALYST
VAPOR FEED
STEAM
REACTOR
PURGE STEAM
SPENT CATALYST
COMBUSTION AIR
AIR HEATER
KILN
COOLING COILS
VENT
REGENERATED CATALYST
VENT
VENT
SURGE HOPPER
FLUE GAS VENT
ELUTRIATOR
LIFT LINE
SECONDARY LIFT AIR
PRIMARY LIFT AIR
FLUE GAS VENT
VENT
VENT
CYCLONE SEPARATOR
AIR HEATER
FRACTIONATOR
HEAVY FUEL OIL
STRIPPER
HEATING OIL
CONDENSER
GAS SEPARATOR
CATALYTIC GASOLINE
WET GAS

Catalytic Reforming—SINCLAIR REFINING COMPANY

Application—This process is applied to the upgrading of low-octane naphthas and the production of aromatics.

Charge—Straight-run naphthas (typical examples shown in Table 1) and cracked stocks of similar boiling range.

Product—Motor fuel blending stock of 85-98 octane (research clear) depending upon operating conditions. When operated for aromatic production, the product may contain benzene, toluene, xylene, or other aromatics depending upon the feedstocks and operating conditions used. The above aromatics may also be found in the motor fuel product and can be extracted by any of several known extraction processes.

Description—The accompanying flow diagram illustrates a typical commercial design. Naphtha is charged to a preheater after mixing with a hydrogen-rich gas stream that is recycled from the reactor product system. The gas-liquid stream is heated to the desired temperature and fed to the top of the No. 1 reactor. The vapors leaving this reactor are reheated and fed to the second reactor. After the No. 2 reactor the stream is again reheated before entering the No. 3 reactor. The effluent from the third reactor is passed through coolers and a flash drum. In this drum the total reactor effluent is separated into a liquid and gas fraction. The gas fraction, being high in hydrogen content, is compressed and recycled to the inlet naphtha feed system. The liquid fraction is fed into a column for stabilization to produce the debutanized reformate product. Hydrogen is produced in excess of process requirements and may be utilized in other processes.

The regenerative nature of the platinum catalyst makes possible the application of two different reforming processes governed by the severity of operation. When processing under relatively mild conditions, it is only necessary to practice infrequent regeneration since the catalyst loses activity slowly. Such operations are essentially continuous and are characterized by low temperatures, high pressures, and high space velocities.

The processing for high octane levels requires higher temperatures and lower space velocities. The use of lower pressures is indicated because of potential yield improvement; however, more frequent regeneration is required. The design for this operation is such that the reactors may be regenerated separately without interruption of the naphtha processing cycle. It is necessary to provide an additional reactor and suitable manifolding so that any one reactor may be taken out of service and regenerated.

Regeneration after mild operations is accomplished by depressuring, purging the system with inert gas, and admitting a controlled amount of air to the reactors to burn-off the carbonaceous material which had fouled the catalyst; the flame front progressing through each reactor in series. Regeneration during high severity operation may be performed in a similar manner on any individual reactor while the others remain on stream.

The catalyst is characterized by (1) high paraffin cyclization, (2) maximized naphthene dehydrogenation, (3) high paraffin and napthene isomerization, (4) high hydrogen production and (5) low hydrocracking. Depending upon the type of operation the catalyst life may vary from 40-200 barrels per pound. The catalyst is a joint development of the Sinclair Refining Company and Baker & Company.

Operating Conditions—Conditions vary with the feedstock and yields desired: 200-750 psig, 825-950 F., 1 to 5 weight hourly space velocity and 3 to 10 molal recycle gas ratio.

Typical Yields—See Table 2.

Commercial Installations—Three under contruction.

TABLE 1

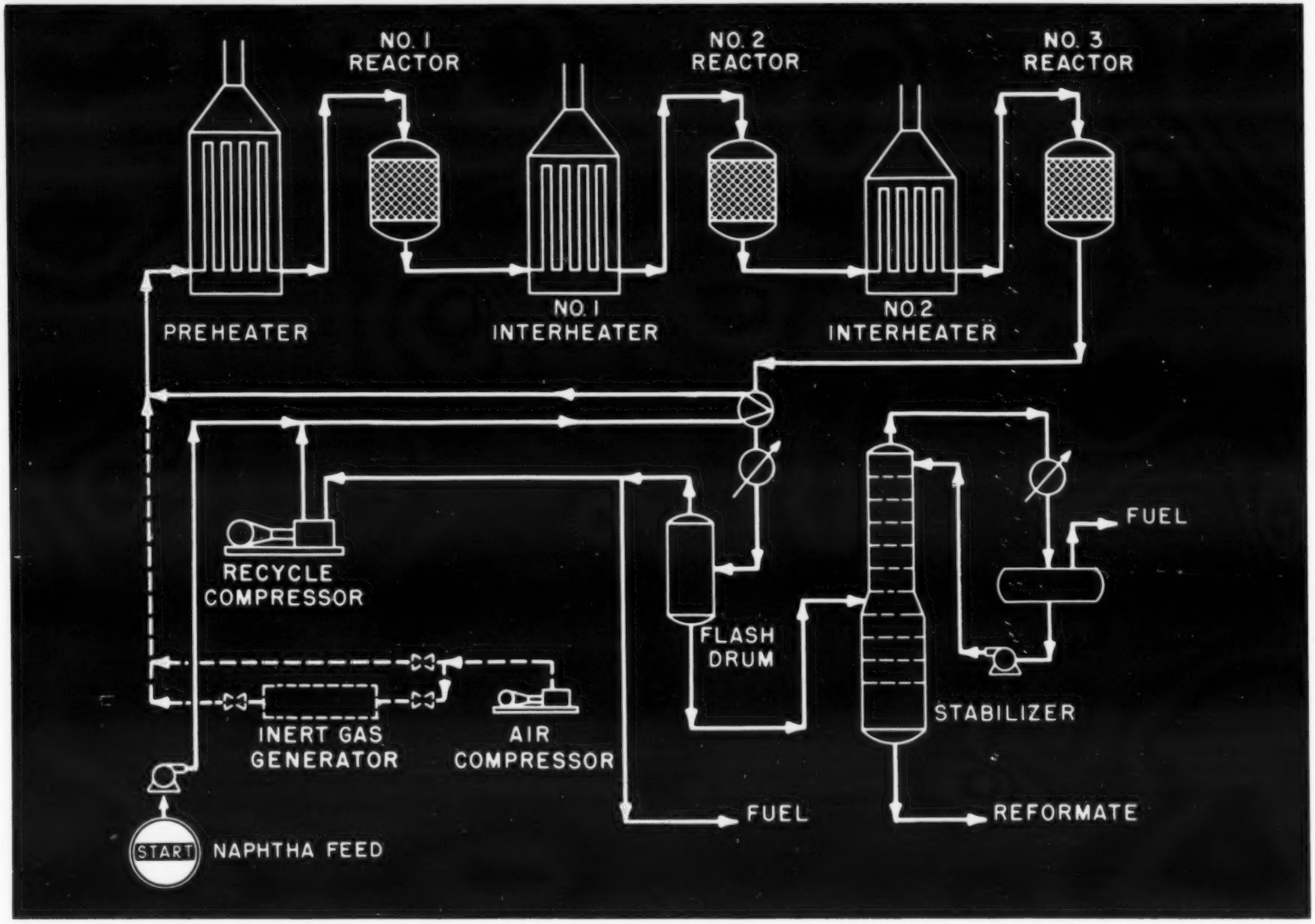
Typical Feed Stock Characteristics

CRUDE SOURCE	Mid-Continent	Abqaiq-Kuwait
Distillation		
Gravity °API	53.9	56.0
IBP °F	253	228
10 Percent °F	266	252
50 Percent °F	289	286
90 Percent °F	333	340
EP °F	360	370
Analysis		
Naphthenes Volume Percent	41.4	20.0
Aromatics Volume Percent	7.3	13.0
Paraffins Volume Percent	50.6	67.0
Sulfur Wt. Percent	0.015	0.045
Octanes		
Research Clear	38.2	35.0
Research + 3.0 cc TEL/Gallon	65.0	58.5

TABLE 2

Pilot Plant Yield Data
Mid-Continent and Abqaiq-Kuwait Naphthas

Reformate Research Octane Crude Source	85 M-C	85 A-K	95 M-C	95 A-K
Yields				
Hydrogen Weight Percent	1.7	0.8	1.8	1.1
Methane Weight Percent	1.0	1.2	1.8	2.0
Ethane Weight Percent	1.6	2.4	2.8	3.8
Propane Weight Percent	2.5	4.0	4.2	6.2
Total C_3- Weight Percent	5.1	7.6	8.8	12.0
Butanes Volume Percent	3.6	6.1	6.2	9.7
C_5-EP Volume Percent	87.3	84.9	80.8	75.9
Octanes				
Research Method Clear	85.0	85.0	95.0	95.0
Research Method + 3.0 cc TEL/Gallon	94.6	95.5	100.1	100.2
Motor Method Clear	78.6	78.6	85.7	85.7
Motor Method + 3cc TEL/Gallon	87.0	88.5	91.1	92.2


NO. 1
REACTOR
NO. 2
REACTOR
NO. 3
REACTOR
PREHEATER
NO. 1
INTERHEATER
NO. 2
INTERHEATER
RECYCLE
COMPRESSOR
FLASH
DRUM
FUEL
STABILIZER
INERT GAS
GENERATOR
AIR
COMPRESSOR
FUEL
REFORMATE
START
NAPHTHA FEED

Catforming—THE ATLANTIC REFINING COMPANY

Application—The Atlantic catalytic reforming process is a selective catalytic process for the conversion of low-octane naphthas into finished high-octane gasoline and for the production of aromatics for petrochemicals and aviation gasoline.

Charge—Stocks for the process may consist of low or high-sulfur, wide-boiling-range, straight-run naphthas (up to 400 F), cracked naphthas, or selective cuts for special aromatics production.

Product—When operated for motor gasoline production, the reactor product requires only stabilization before inclusion in finished gasoline. No rerunning, sweetening or other finishing treatment is required.

Description—Feed naphtha is charged to the reaction section with no feed preparation facilities required. The feed is joined with a recycle gas stream of 90 to 95 percent hydrogen purity and preheated by exchange with the final reactor effluent. The mixture is then heated before passing to the first reactor. Three reactors are utilized in series with interheaters between reactors to compensate for the endothermic heat of reaction. The final reactor effluent after exchange with the feed is cooled and flows to a high pressure gas separator. The recycle hydrogen stream (approximately 3000 cubic feet per barrel of feed) is compressed and returned to the reactors. The net gas make consisting of hydrogen and small quantities of methane and ethane is sent to fuel gas or other use. Liquid from the separator flows to a conventional fractionation system for stabilization.

When charging high sulfur stocks it is economically desirable to include desulfurization facilities. In the Atlantic process this is accomplished by a simple desulfurization of the recycle gas, such as a conventional amine unit. Since neither water or amines are catalyst poisons, no special equipment is required following the desulfurization unit. By desulfurization of the recycle gas when charging a feed containing 0.1 weight percent sulfur, the sulfur content of the reactor charge is equivalent to that which would exist when charging a feed of .025 weight percent sulfur with no desulfurization.

Carbon deposition on the catalyst is negligible under normal operations with this process. Under very severe reforming conditions or in the case of a major unit upset, however, carbon may be deposited on the catalyst reducing its activity. With the Atlantic process this is corrected by a simple regeneration operation, with the catalyst in place, using a dilute air in steam mixture to burn off the carbon deposit.

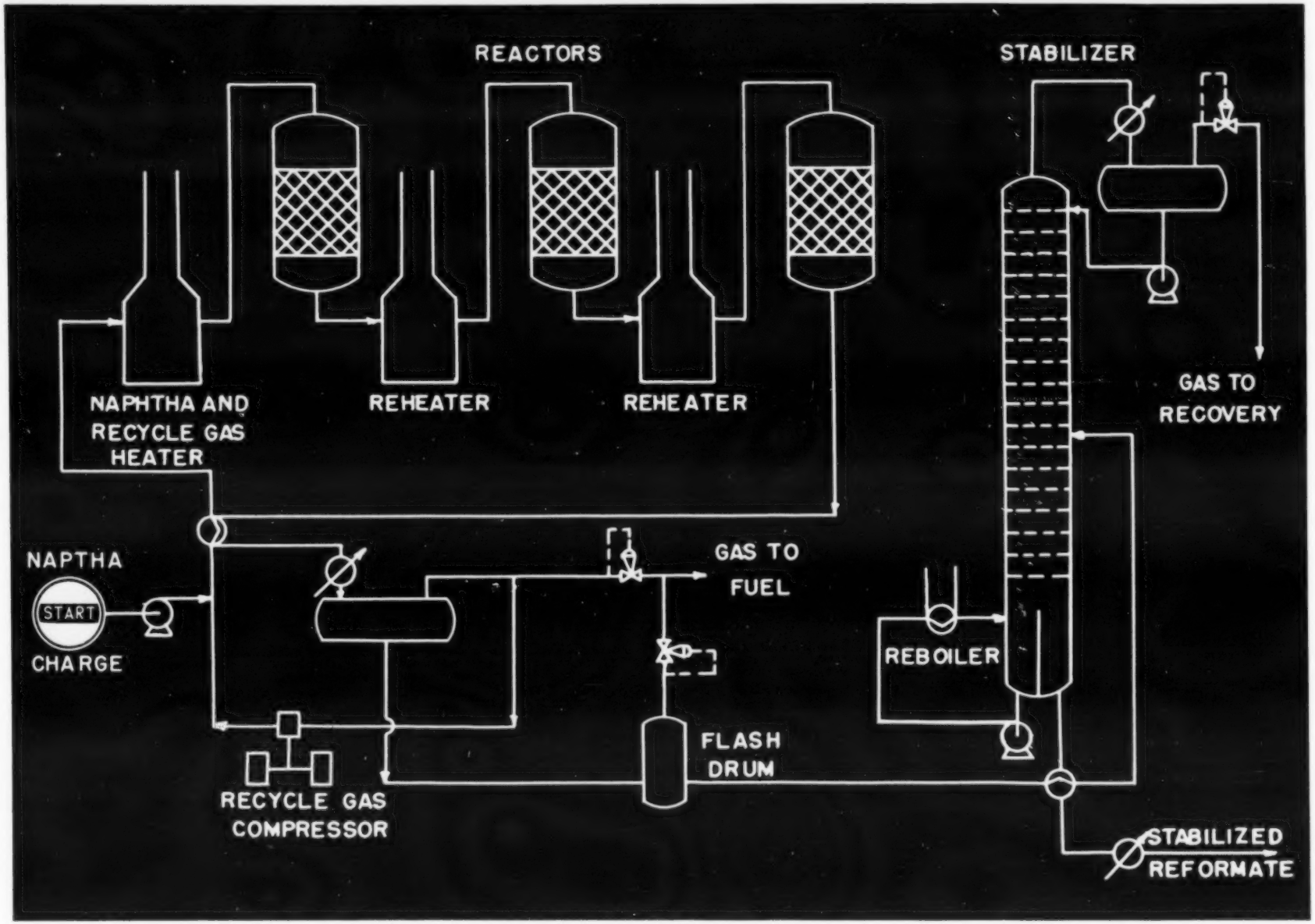
The process is based upon a selective catalyst which promotes the following chemical reactions: isomerization of paraffins and naphthenes, conversion of naphthenes to aromatics, hydrocracking of high boiling paraffins with cleavage of paraffins near the central carbon atom, and desulfurization with the production of hydrogen sulfide.

Operating Conditions—Reactor temperature is 850-950 F., while the pressure is maintained at 300-700 psi. Product yields and qualities will depend to a large extent on the properties of the feed and the operating severity employed.

Yields—Typical charges, yields and inspections are shown in the table below.

Commercial Installations—Since the first commercial operation of the Catforming process began in August, 1952, twelve additional units have been completed and put in operation. These and several other units in various stages of design and construction are operating on widely variant feed stocks. Capacities of the operating units range from 300 to 14,000 barrels per day.

STOCK	East Texas		Arabian		California	
Charge Stock:						
ASTM—10 Percent	236		268		284	
50 Percent	268		294		319	
90 Percent	317		334		365	
Percent Sulfur	.005		.03		.028	
F-1 Octane Clear	51.5		37.4		54.0	
Products:						
Debut. Gaso.—LV Percent	86.7	84.4	84.6	75.7	93.5	88.0
C_4—LV Percent	6.3	8.2	11.3	17.2	2.6	6.1
C_3—Weight Percent	2.5	3.4	4.0	6.3	1.2	2.2
C_2—Weight Percent	0.3	0.4	0.7	2.2	0.1	0.5
C_1—Weight Percent	0.1	0.2	0.2	0.6	0.1	0.3
H_2—Weight Percent	1.9	1.9	0.5	0.5	1.3	1.7
RVP Debut. Gaso.	2.4	2.7	2.4	3.7	1.6	2.5
F-1 Octane-10 lb. Gasol.:						
Clear	89.9	92.9	86.4	93.0	83.9	93.6
+3cc TEL	97.8	99.2	96.3	....	94.3	99.6
ASTM—10 Percent	201	187	184	160	259	212
50 Percent	261	258	279	263	316	309
90 Percent	329	323	342	354	377	380
Sulfur	.001	.001	.001	.001	.001	.001


REACTORS
STABILIZER
NAPHTHA AND
RECYCLE GAS
HEATER
REHEATER
REHEATER
GAS TO
RECOVERY
NAPTHA
START
CHARGE
GAS TO
FUEL
REBOILER
FLASH
DRUM
RECYCLE GAS
COMPRESSOR
STABILIZED
REFORMATE

Cycloversion—PHILLIPS PETROLEUM COMPANY

Application—Cycloversion is used (1) to desulfurize straight run and cracked gasolines, naphtha fractions and kerosines, (2) to reform straight run gasoline or naphtha in order to up grade octane numbers and to improve lead susceptibility, (3) to catalytically crack gas oil stocks for the production of high octane gasoline. It is also used for the catalytic retreatment of highly olefinic synthetic gasoline.

Charge—Under desulfurization conditions the charge stocks can be either a full boiling range gasoline or a naphtha fraction. Various mixtures of cracked and straight run charge stocks can be processed in a combined operation. Under reforming conditions the charge stocks are similar to those processed to effect desulfurization. Gas oil cracking charge stocks having a boiling range 400-800 F. can be satisfactorily processed.

Product—Catalytic desulfurization of the straight run or natural gasoline charge stocks results in no appreciable change in the composition of the treated product other than the reduction of sulfur content. With cracked gasoline the octane improvement is due to desulfurization and some isomerization. The absence of undesirable side reactions is indicated by the fact that there is no appreciable change in physical properties such as vapor pressure, gravity or distillation characteristics.

Benefits gained by catalytic reforming include those obtained from catalytic desulfurization together with an appreciable increase in clear and leaded octane ratings.

Catalytic gas oil cracking yields highly olefinic gases, high octane motor fuel, low pour point recycle stocks and bottoms.

Description—The accompaning simplified flow diagram shows the basic equipment included in a Cycloversion Unit. The heater and heat exchangers are of conventional design and serve to heat the feed stock to the desired temperature with a minimum of thermal decomposition. Two reactors are provided for continuous operation, i.e., one chamber is on process while the other is being regenerated. The rerun and stabilization facilities are also conventional in design. The steam superheater and air compressor are regeneration facilities which are used for reactivating the catalyst in situ. An installation of this type can be used for any of the applications of Cycloversion. However, rerun and stabilization facilities are not required for straight run desulfurization. Also, some units built for desulfurization service, have only a single reactor and do not include regeneration facilities. These installations discard the catalyst when it is spent and recharge the reactor with new catalyst.

All the equipment shown in the flow diagram is required for gas oil cracking and reforming operations. The higher carbon deposition on the catalyst for either of these operations precludes the use of the non-regenerative unit. Process cycles vary from three to 12 hours when processing gas oil and from 12 to 72 when reforming. Steam is added with the gas oil charge to suppress carbon deposition on the catalyst but is not generally used in the desulfurization or reforming operation.

Caustic washing facilities are generally provided to remove the H_2S formed when the sulfur compounds are decomposed. No further treatment is usually necessary.

The catalyst is cyclocel grade bauxite and is a natural occurring material. It has a life of 5000-20,000 barrels per ton when used in non-regenerative desulfurization units and 50,000-100,000 barrels per ton when used in regenerative units.

Operating Condition—The major process variables are temperature, pressure, and space velocity. High temperatures increase the depth of conversion. Lower pressures increase the olefinicity of the gasoline obtained from gas oil cracking which in turn increases the octane rating of the product. Increasing space velocity at constant temperature and pressure decreases the depth of conversion.

Yields—In the desulfurization operations, the yields are 98.0-99.5 liquid volume percent of charge. Yields from reforming are dependent on the severity of the operation. This is also true for gas oil cracking though in this operation a 50 percent conversion is considered normal. Typical data for the three types of operation which can be performed in the Cycloversion process are shown in the tables below.

Commercial Installations—The first Cycloversion unit was installed in 1940. At present there are 33 units in operation with a total designed thruput of over 100,000 barrels per day. Units totalling more than 29,000 barrels per day are under construction. These units range in size from 300-18,000 barrels daily.

TABLE 1
Cycloversion of Mid-Continent Gas Oil

Feed Stock:		
Gravity, API°	32.2	
10 Percent (Vacuum)	604	
90 Percent (Vacuum)	752	
Aniline Point, °F.	181	
Catalytic Gasoline, C5—400°F.	Test 1	Test 2
Gravity, API°	55.1	54.9
Reid Vapor Pressure	6.0	6.6
ASTM Octane Number	80.4	81.1
+3 cc. TEL	84.5	84.7
Research Octane Number	94.3	94.5
+3 cc. TEL	97.8	98.0
Yields, Precent of Charge:		
Cat. Gasoline, C5-400°F., Vol. Percent	28.6	33.2
10 Lb. RVP., Gasoline, Vol. Percent*	37.4	42.9
Propylene, Vol. Percent	4.1	4.2
Butylenes, Vol. Percent	4.9	5.6
Cat. Recycle 400°F., + Vol. Percent	59.1	50.7
Carbon, Weight Percent	1.5	2.3
Conversion, Single Pass Vol. Percent	40.9	49.3

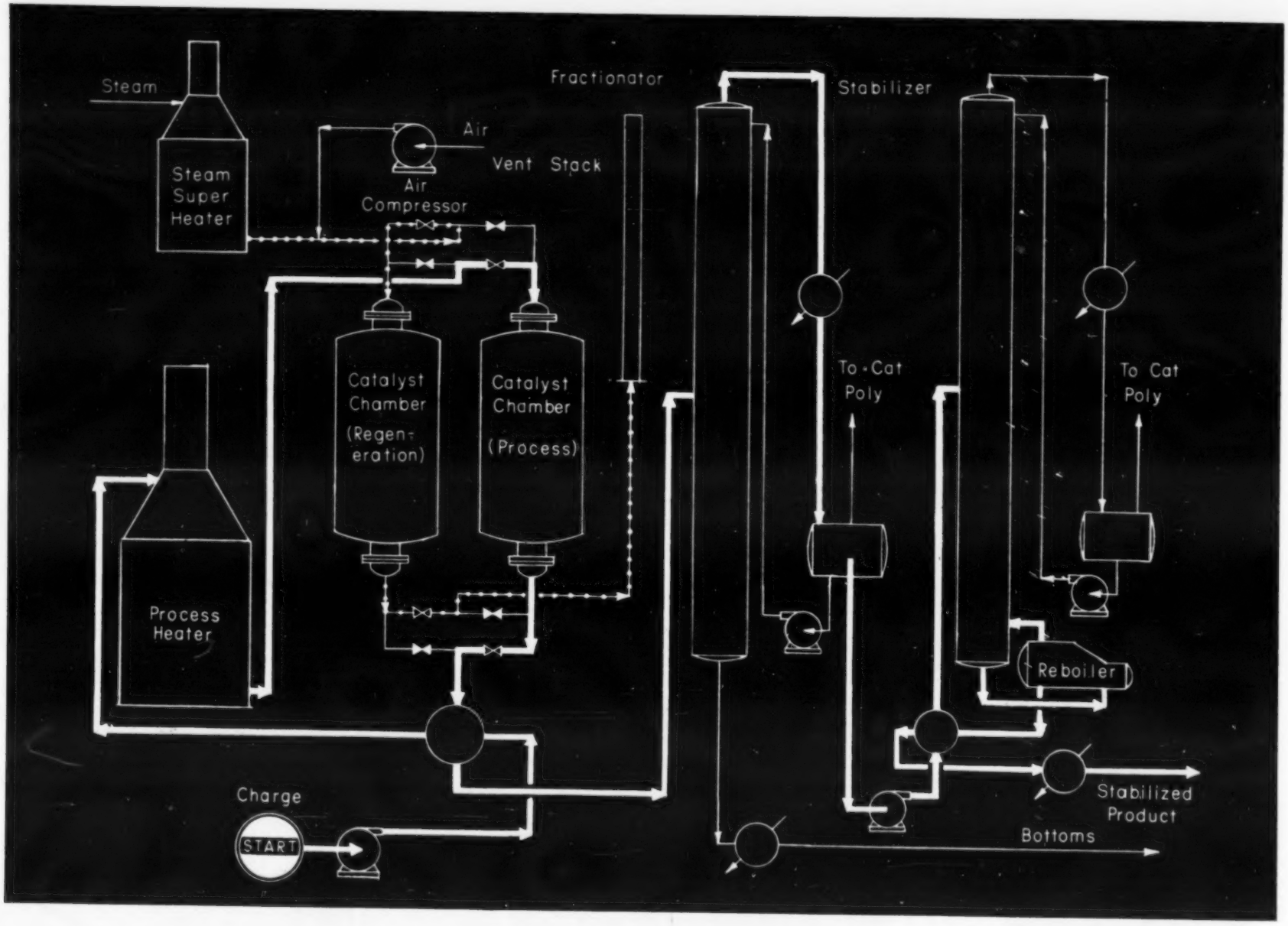
* Butanised and includes potential catalytic poly gasoline.

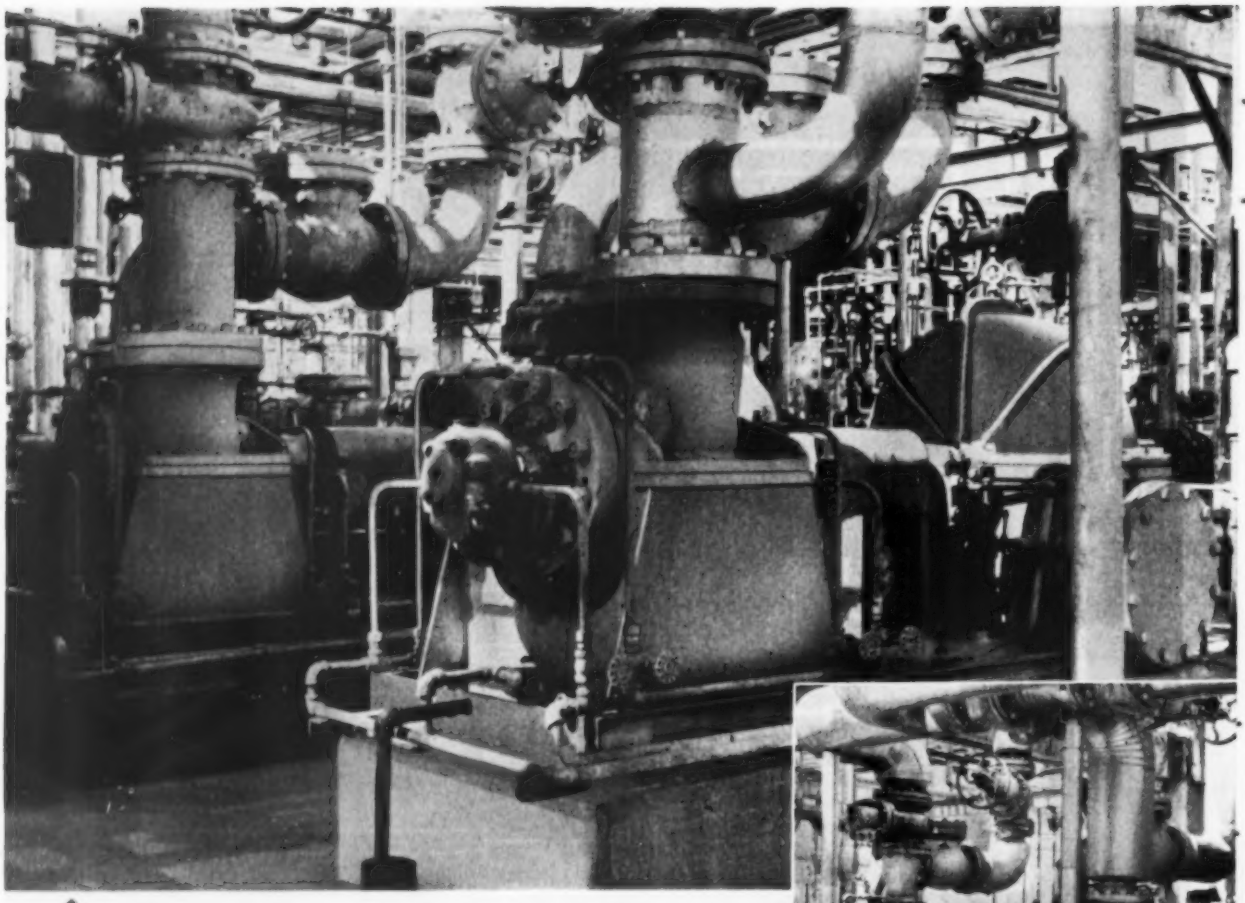
TABLE 2—Reforming

Sample Designation Test Number	Charge	Debutanized Reformed Naphtha	
		One	Two
Operating Conditions:			
Space Velocity, V/V/Hr.		1.0	1.0
Cat. Chamber Inlet, °F.		875	974
Cat. Chamber Pres., Psig.		50	50
Yield Summary:			
Debut. Ref. Naph., Vol. Percent Charge		95.6	88.7
Research Octane Ratings:			
Clear	42.7	52.2	68.0
Plus 1.0 cc. TEL/Gal.	51.0	62.3	75.4
Plus. 3.0 cc. TEL/Gal.	59.4	73.3	83.3
API Gravity @ 60 F.	46.9	46.3	46.1
R.V.P.	1.5	1.1	3.2
Total Sulfur, Weight Percent	0.184	0.011	0.020
ASTM Dist. °F:			
First Drop	271	187	129
10 Percent	312	297	259
30 Percent	324	320	309
50 Percent	334	333	327
70 Percent	346	348	344
90 Percent	365	370	367
End Point	416	429	442

TABLE 3—Desulfurization

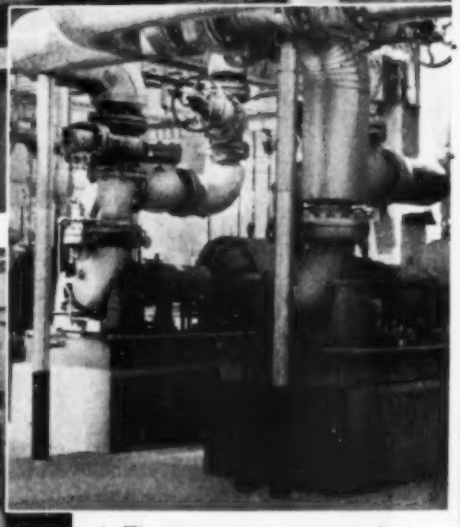
	Straight-Run Gasoline	
	Charge	Product
Operating Conditions:		
Space Velocity, V/V/Hr.		1.0
Cat. Chamber Inlet, °F.		803
Cat. Chamber Pres., Psig.		50
Research Octane Ratings:		
Clear	64.2	66.3
Plus 1.0 cc. TEL/Gal.	71.5	76.6
Plus 3.0 cc. TEL/Gal.	78.1	85.5
Yield Summary:		
Yield, Vol. Percent Charge		99.6
API Gravity @ 60° F.	64.6	63.9
R.V.P.	11.1	10.7
Total Sulfur, Weight Percent	0.123	0.004
Mercaptan Sulfur, Weight Percent	0.049	<0.001
Doctor Test	Sour	Sweet
ASTM Dist. °F.:		
First Drop	94	96
10 Percent	117	131
30 Percent	171	176
50 Percent	207	203
70 Percent	239	239
90 Percent	281	278
End Point	339	343


Steam
Steam Super Heater
Air
Air Compressor
Vent Stack
Fractionator
Stabilizer
Catalyst Chamber (Regeneration)
Catalyst Chamber (Process)
To Cat Poly
To Cat Poly
Process Heater
Reboiler
Charge
START
Stabilized Product
Bottoms



These two I-R single-stage, vertically-split units circulate 950 gpm of solvent through the Aromatics Recovery Plant at 485' head.

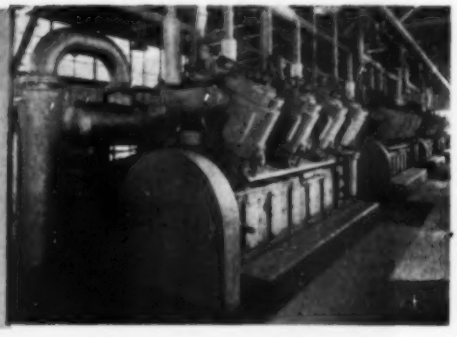
On the toughest of refinery jobs, these I-R slurry pumps have given dependable service. 600° gas oil, containing .8 lb/gal of catalyst is circulated through heat exchangers.



These two-stage pumps charge the Platformer with depentanized gasoline or naptha. Similar units are on boiler feed service at Cosden.

I-R COMPRESSORS SERVE CAT-CRACKER AND PLATFORMER

The four Ingersoll-Rand gas-engine-driven units at the right compress recovery gas from the cat-cracker to 215 psig. Their successful performance record has resulted in the installation of five other gas-engine compressors at Cosden.



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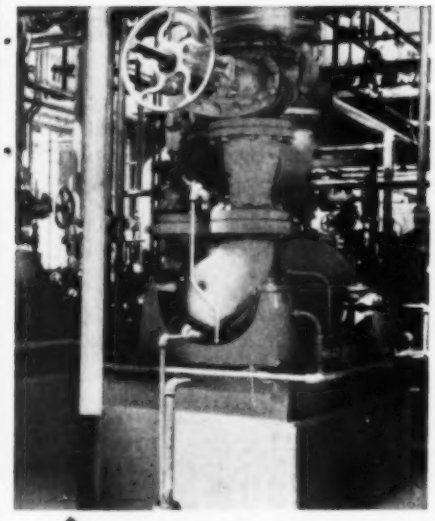
...at Cosden Petroleum Corporation, in West-Central Texas.



Three I-R vertically-split, single-stage pumps on feed preparation service for Cosden's Platformer.

The Cosden Refinery in Big Spring, Texas marks the first installation of a combination Platforming and Aromatics Recovery Plant for simultaneous production of nitration-grade benzene, toluene and xylene from petroleum hydrocarbons.

Here, as at all petroleum processing plants, *centrifugal pumps* are the heart of the entire operation—circulating the liquids that constitute its "life blood" through miles of piping, processing units and storage tanks. To stay "on stream," operating engineers can take no chances on performance and dependability when it comes to process pumps.

At Cosden, as in refineries the world over, Ingersoll-Rand pumps and compressors are living up to their reputation for continuous, heavy-duty performance year after year, with minimum attention and maintenance.

Whatever your processing requirements, Ingersoll-Rand's specialized experience in the petroleum field can save you time, trouble and expense. For information, contact your nearest I-R branch office.

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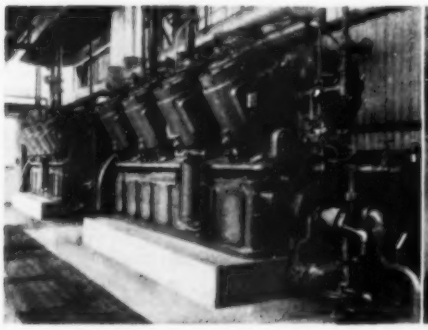
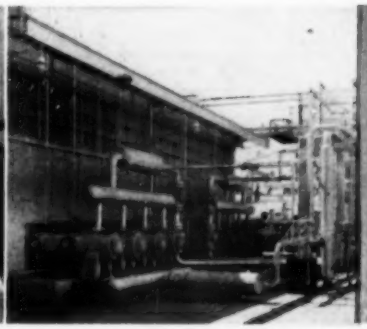




Two Ingersoll-Rand 8 XVG gas-engine-driven compressors, with non-lubricated compressor cylinders, supply clean, oil-free hydrogen to the Platformer at 850 psig. Compressor cylinders are outside the building, separated by fire-wall construction as shown in the first photo at left. A third unit is now being installed to increase capacity.

GAS & DIESEL ENGINES • VACUUM EQUIPMENT • PUMPS • COMPRESSORS

For more data on advertised products, use Readers' Service Cards, last page.

Fluid Hydroforming—STANDARD OIL DEVELOPMENT COMPANY

Application—Fluid Hydroforming is a flexible, fully continuous, catalytic, fluidized solids process for converting low octane naphthas to high octane gasoline stocks. The recently announced Model II version lowers investment costs up to 20 percent and increases the flexibility of the process.

Charge—Both virgin and cracked stocks can be reformed with good selectivity. There is no limitation in feed stock end point, and high sulfur feeds can be reformed without the use of desulfurization equipment.

Product—Good yields of high octane gasoline are obtained, especially when paraffinic feed stocks are reformed. The octane ceiling is higher than for other known methods of reforming.

Description—Finely divided molybdena-alumina catalyst, behaving much like a fluid, circulates continuously between the reaction and regeneration zones of the process. In the reactor, the preheated feed stock comes into intimate contact with catalyst and recycled tail gas, and is reformed into high octane products. Carbonaceous material which accumulates on the catalyst is burned off in the regenerator, and the hot regenerated catalyst is returned continuously to the reactor.

The catalytic reforming reactions require a substantial heat input to the reactor at a relatively high temperature level. The Model II version of the process provides a new source of heat and thus eliminates some of the expensive equipment formerly needed to supply heat. Previously all the heat was conveyed to the reactor as sensible heat of the naphtha feed, recirculated catalyst, and recycle tail gas. In Model II the new heat source is an inert solid stream which circulates with the catalyst between the reactor and regenerator, and which conveys into the reactor the heat of regeneration which cannot be transported economically by the catalyst itself.

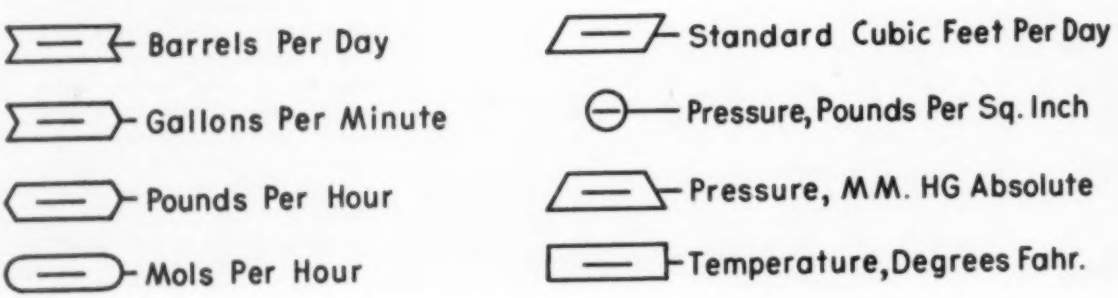
The inert particles are larger and more dense than the catalyst particles, and therefore settle rapidly through the fluid beds of catalyst in the reactor and regenerator. Because of this, the inert particles can be circulated through the system many times faster than the catalyst itself, and all the heat of regeneration is transported to the reactor. The result is a considerable reduction in the heat required from the recycle-gas stream, and investment savings of about 20 percent in compressors, furnaces, heat exchangers, cooling water, and power.

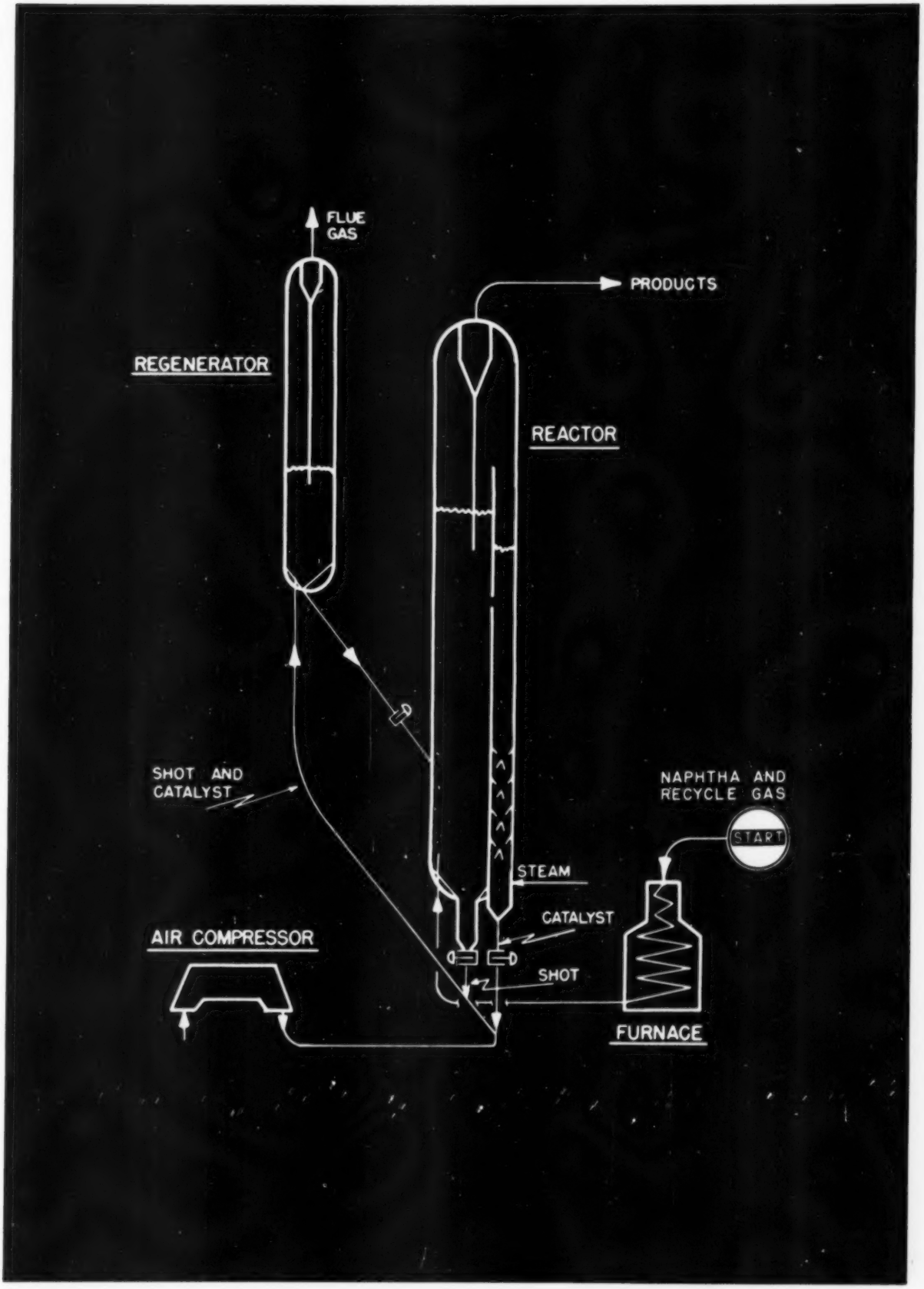
Optimum Model II conditions for Hydroforming a 250 F. to 325 F. West Texas virgin naphtha to produce a clear 92-octane-number (ASTM D 908, Research Method) C_5+ gasoline are as follows:

Reactor:	
Pressure, psig	200
Temperature, F.	900
Recycle gas—	
Rate, cu. ft. per bbl. of feed	2,000
Preheat temperature, F.	1,000
Naphtha—	
Preheat temperature, F.	1,000
Solids circulation, pounds per pound of naphtha feed:	
Catalyst (catalyst-to-oil ratio)	0.6
Inert particles (inerts-to-oil ratio)	3.1
Regenerator:	
Pressure, psig	200
Temperature, F.	1,125
Air Standard, cu. ft. per bbl. of feed	685

Commercial Installations—At the present time 127,000 barrels per day of Fluid Hydroforming capacity are under construction or are operating in the U. S. and throughout the world. These units are of the Model I design. It is anticipated that new Fluid Hydroformers will use the Model II design, which has also recently been made available to the industry under license.

Flow Diagram Symbols Used In This Issue...

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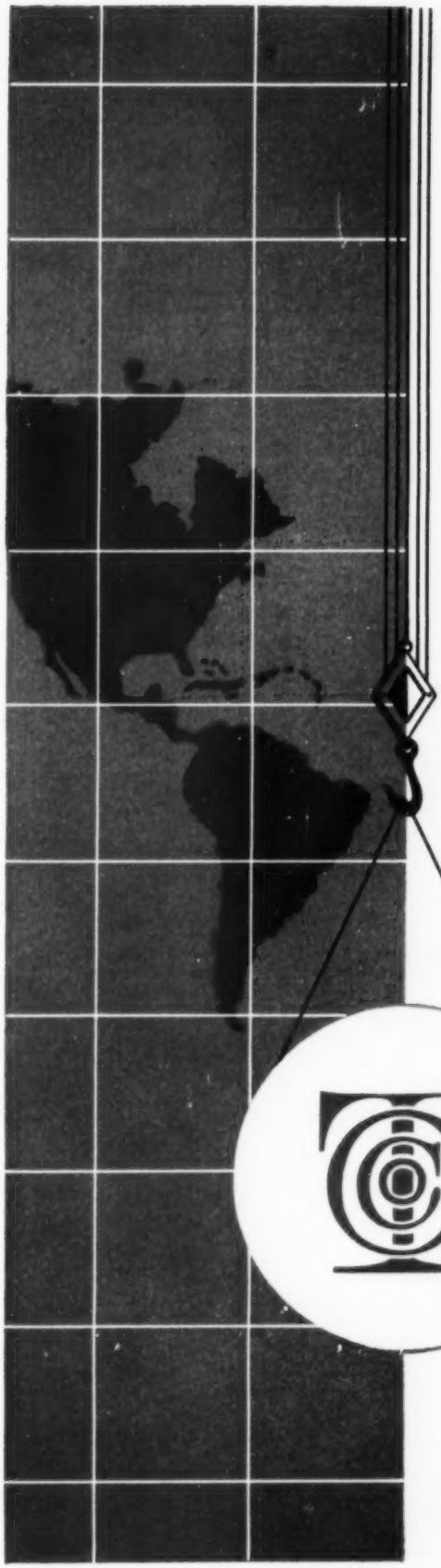

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Fluid Hydroforming—THE M. W. KELLOGG COMPANY

Application—The Fluid Hydroforming process is used to catalytically reform straight run and cracked naphthas or mixtures of the two to high octane levels.

Charge—A wide variety of either straight run or cracked naphthas or mixtures can be used as feed stock to the unit. A normal boiling range for these naphthas may be considered as 200 to 400 F. although other fractions may also be used. Some inherent advantage in yield is obtained by using highly naphthenic or aromatic naphthas, but extremely high octane products can also be obtained from highly paraffinic naphthas. High sulfur naphthas can be processed successfully without extraneous desulfurization systems.

Product—A fluid hydroformer product has both a high octane and a high aromatic content. It can therefore be used as either a high octane blending agent for motor or aviation gasoline or as a source of aromatic petrochemicals. The plants now under design will produce a debutanized product having an 85 to 95 CFR-Research clear octane rating.

Description—The naphtha charge is preheated in one coil of the combination furnace, and the hydrogen recycle gas is heated in a separate coil. These two streams are contacted with the regenerated catalyst in the reactor, and the reaction products are separated in a conventional recovery system. The spent catalyst from the reactor is continuously withdrawn to a regenerator where the carbon content is reduced to the required value by combustion with air. The hot regenerated catalyst is then returned to the reactor for further contact. This makes the process truly continuous and allows a part of the heat of reaction to be supplied by the recirculated catalyst.

This catalyst circulation system makes possible very close control of catalyst activity at all times and permits a low feed preheat temperature. Fresh catalyst can be added when required, or used catalyst can be withdrawn while the unit is in continuous operation. A low feed preheat temperature minimizes the amount of pre-cracking of the naphtha which might occur if all the heat required for the reaction were added in the furnace coil. By using a circulating catalyst system, very high octane levels can be attained without the possibility of shut-down due to coke formation on the catalyst.

Operating Conditions—Since the operation of the Fluid hydroforming unit will depend to a large extent on the feed stock and the product desired, only a broad range of operating variables can be given. An approximate range of these variables for commercial units is as follows:

Reactor pressure	200-500 psi
Reactor temperature	900-950 F.
Regenerator pressure	210-510 psi
Regenerator temperature	1000-1100 F.
Hydrogen recycle gas rate	4000-8000 SCF/Bbl.
Space velocity	0.30-0.80 W/Hr./W
Catalyst to oil ratio	0.25-1.00 W/W

Yields—Tables 1 and 2 illustrate typical yields and inspections of products when making aromatics, aviation gasoline, and motor gasoline.

Commercial Installations—A 2000-barrel-per-day plant is in operation at Destrehan, La., producing either high-quality motor gasoline or aviation gasoline components. One 13,000-bpsd, one 20,000-bpsd, and one 30,000-bpsd plant are expected to be in operation in late 1954 or early 1955.

TABLE 1

Fluid Hydroforming of 214/291° Virgin Naphtha for Aromatics or 115/145 Grade Aviation Gasoline

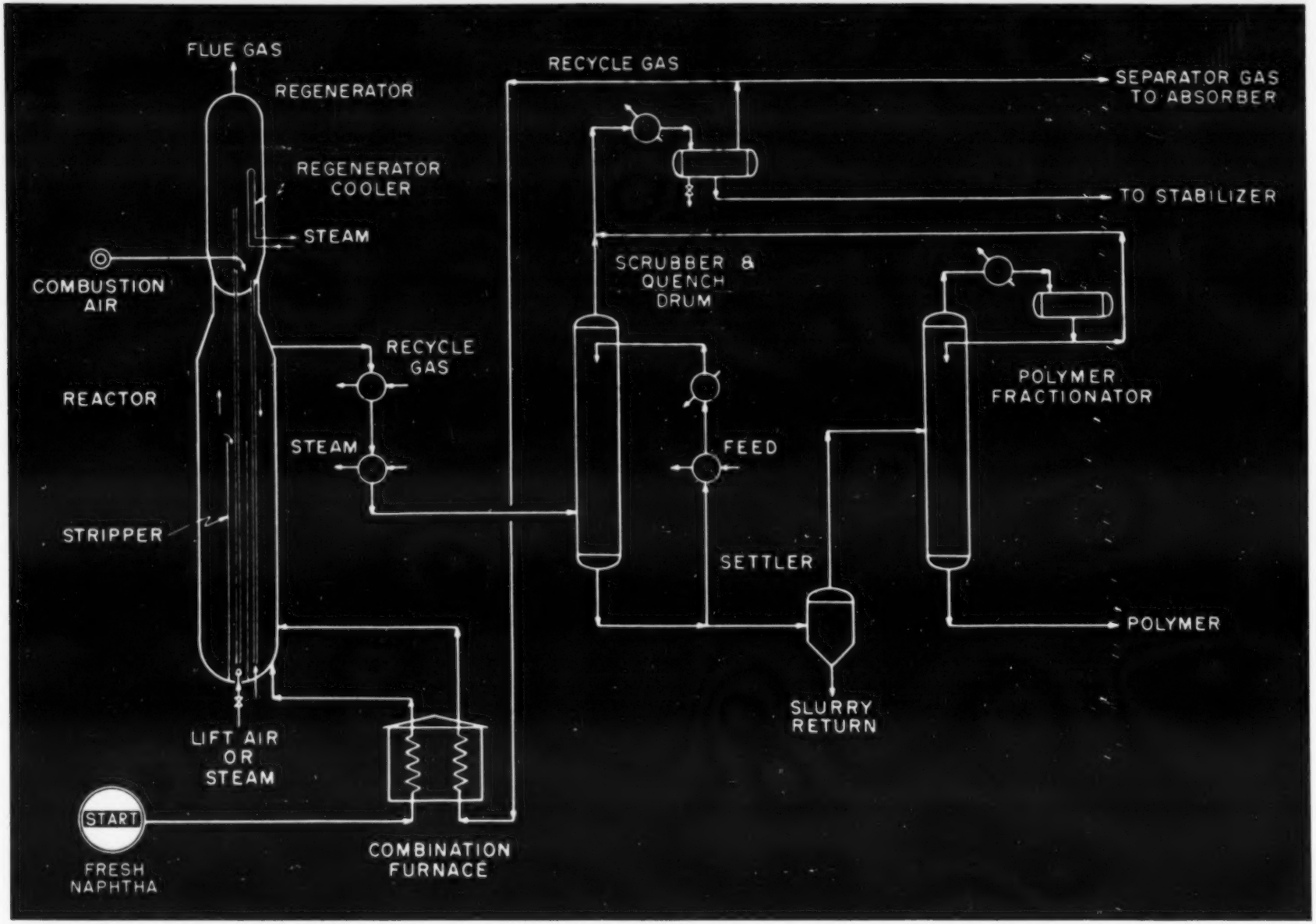
Operating Conditions:	
Pressure—psig	250
Temperature—F.	934
Yields on Feed:	
100 Percent C_4 Liquid—Volume Percent	83.0
C_4 Fraction—Volume Percent	6.9
Butenes	0.1
Isobutane	2.9
n-Butane	3.9
C_5 Fraction—Volume Percent	7.2
Isopentane	3.8
n-Pentane	3.4
Depentanized Liquid—Volume Percent	68.9
Pre-Aviation Blending Agent—Volume Percent	22.8
Aviation Blending Agent—Volume Percent	33.5
Post-Aviation Blending Agent—Volume Percent	12.6
Carbon—Weight Percent	0.37
Hydrogen Produced—CF/B	740
Benzene—Volume Percent	1.6
Toluene—Volume Percent	15.8
C_8 Aromatics—Volume Percent	15.4
C_9 Aromatics—Volume Percent	6.8
Inspections of Products:	
Debutanized Liquid:	
Octane Number—CFRR	95.2
Pre-Aviation Blending Agent:	
Reid Vapor Pressure—psi	2.9
Octane Number—CFRR+3 cc TEL	91.8
Blending Octane Number—F-3+4.6 cc TEL	94.2
Blending Index Number—F-4+4.6 cc TEL	89.5
Aviation Blending Agent:	
Reid Vapor Pressure—psi	0.4
Blending Octane Number—F-3+4.6 cc TEL	100
Blending Index Number—F-4+4.6 cc TEL	216
Post-Aviation Blending Agent:	
Reid Vapor Pressure—psi	0.5
Octane Number—CFRR	>100

TABLE 2

Typical Fluid Hydroforming Pilot Plant Results Virgin Naphthas—Motor Gasoline Production

CHARGE STOCK SOURCE	Mid-Continent	Kuwait
Charge Stock:		
Gravity—°API	56.1	55.4
ASTM Distillation:		
IBP—F	204	206
10 percent	235	264
50 percent	269	299
90 percent	329	346
95 percent	351	360
EP	373	381
RVP	1.0	0.7
Sulfur—weight percent	0.03	0.073
CFRM Clear (F-2)	39.1	28.8
CFRR Clear (F-1)	40.9	30.2
Operating Conditions:		
Catalyst	Molybdena on Alumina	Molybdena on Alumina
Pressure—psig	250	250
Temperature—F	930	930
Recycle Gas—CFPB	5000	5000
Fluid Hydroformate:		
10# RVP Yield—Vol. percent basis feed	88.7	83.4
10# RVP Octane:		
CFRR Clear	90.7	92.1
CFRR+3cc TEL/gal.	99.6	100.0
Extraneous Butanes* Volume Percent basis feed	3.4	0.6
Butanes produced—Volume Percent basis feed	6.4	8.2
Debutanized Hydroformate:		
Gravity—°API	48.4	48.5
ASTM Distillation:		
IBP—F	133	112
10 percent	184	169
50 percent	250	259
90 percent	319	341
95 percent	352	368
EP	435	436
RVP	3.00	4.2
Sulfur—weight percent	0.010	0.010

* Required for 10-pound RVP Gasoline.


FLUE GAS
REGENERATOR
REGENERATOR COOLER
STEAM
COMBUSTION AIR
REACTOR
RECYCLE GAS
STEAM
STRIPPER
LIFT AIR OR STEAM
START
FRESH NAPHTHA
COMBINATION FURNACE
RECYCLE GAS
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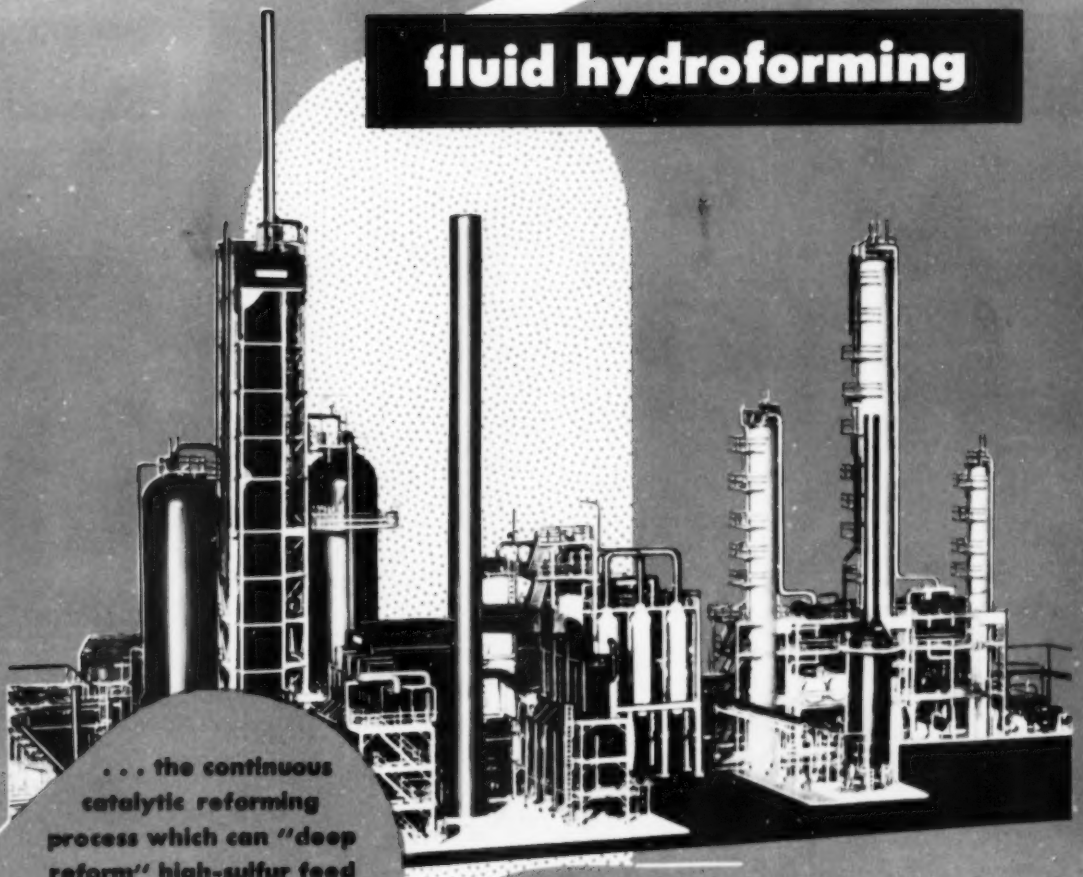
fluid hydroforming



. . . the continuous catalytic reforming process which can "deep reform" high-sulfur feed stocks without rapid catalyst deterioration.

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This Fluid Hydroformer is part of an expansion program at "Creole's" Amuay Bay, Venezuela refinery for which Foster Wheeler is the main contractor; also included are a 75,000 bbl/day Crude Distillation unit, a Naphtha Fractionation-Stabilization unit and extensive offsite facilities.

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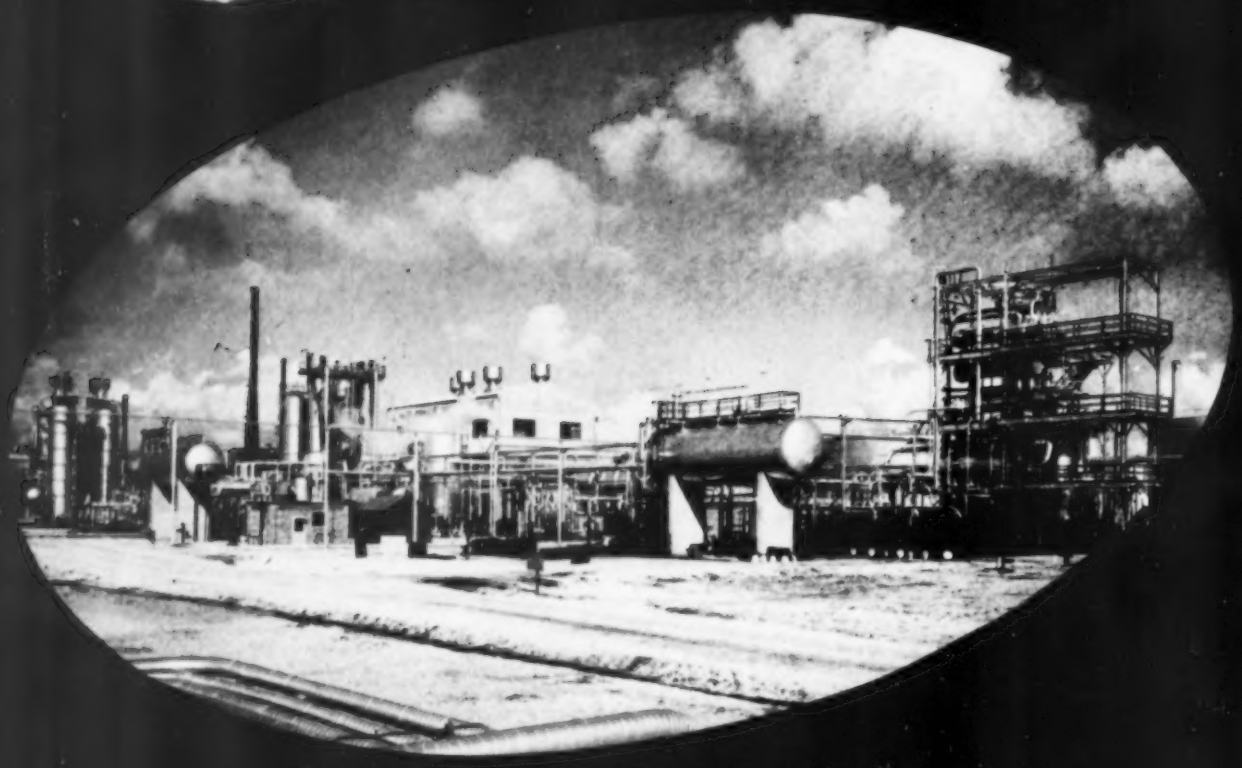

the Fawley lube plant

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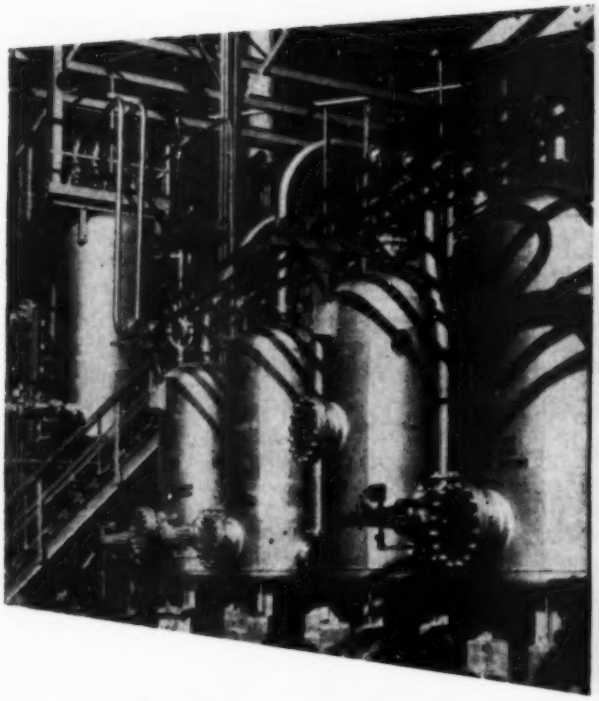

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Houdriforming—HOUDRY PROCESS CORPORATION

Application—Houdriforming is a continuous catalytic reforming process applicable to the reforming of petroleum naphthas for the production of high-octane motor gasoline, aviation blending stocks and aromatics.

Charge—Straight-run and cracked petroleum naphthas boiling up to 400 F. end point can be processed. Actual boiling ranges of the charge stocks will be influenced by the type of products desired. In aromatics production operation will be optimum on selected narrow boiling fractions rich in the hydrocarbons from which the aromatics are formed. For motor gasoline operation, naphthas within the 200-400 F. boiling range are usually the preferred charging stocks.

Product—In the production of motor gasoline from average stocks it is feasible to produce debutanized reformates having F-1 clear octane values in the 90-95 range. The actual octane level required to balance over-all gasoline quality will necessarily determine the degree of severity used in the reforming step. In general it is more economical to operate at lower severity levels where unusually high liquid recoveries are obtained (see Table 1).

When producing aromatics—benzene, toluene, xylenes, and ethyl benzene—yields are commonly realized that represent naphthene conversion efficiencies of over 90 percent of the thermodynamic equilibrium values. Concentrated aromatic fractions can be separated from the reformates by distillation to provide excellent aviation blending components. With the inclusion of appropriate purification equipment, the process provides an effective means for the manufacture of nitration grade benzene and toluene as well as high purity mixtures of xylenes and ethyl benzene.

When operating for either motor gasoline or aromatics, hydrogen of good purity is produced as a by-product.

Description—A highly selective, dual-function catalyst is used in the Houdriforming process to promote reactions which consist predominantly of dehydrogenation, isomerization, aromatization, hydrocracking and desulfurization. Dehydrogenation and dehydroisomerization of naphthenes permits the production of aromatic concentrates such as benzene, toluene and xylenes from naphthene rich naphtha fractions. The same reactions plus isomerization and aromatization of paraffins result in high yields of high-octane motor gasoline from straight-run naphtha fractions.

In the accompanying flow diagram, the process flow of a typical plant may be traced.

The naphtha charge is joined by a hydrogen-rich recycle gas stream and the combined streams flow first through heat exchange and then through a fired preheater into the No. 1 reactor. The reactants undergo a temperature drop in passing through the reactor because of the endothermic heat of reaction. The temperature level is adjusted by passing the partly reacted material through a reheat coil before continuing the reaction in No. 2 reactor. Passage through a second reheater and the No. 3 reactor completes the hydrocarbon conversion.

The reactor effluent from the last reactor is cooled by heat exchange with the reactor charge stream and cooling water and then flashed in the high pressure flash drum. A portion of the vapors from the flash drum is delivered to the recycle gas compressor for compression and returned to the reactors; the net make gas is released to the refinery fuel gas system.

The flash liquid is then pumped into a conventional stabilizer tower. Stabilized gasoline is produced as bottoms product with the vapor product taken overhead for delivery to the fuel gas system or utilized for other purposes since the gas is rich in hydrogen.

Operating Conditions—The major process variables are temperature, space velocity, pressure, and hydrogen/oil recycle ratio. By the proper manipulation of these controls it is possible to vary the reforming severity widely as may be required in either motor gasoline or aromatics operation. Typical operating conditions will fall within the range of 875 to 950 F. temperature, 250 to 600 psig pressure, 1.5 to 5.0 space velocity (V/hr./V), and hydrogen/oil mole ratio of 4 to 10.

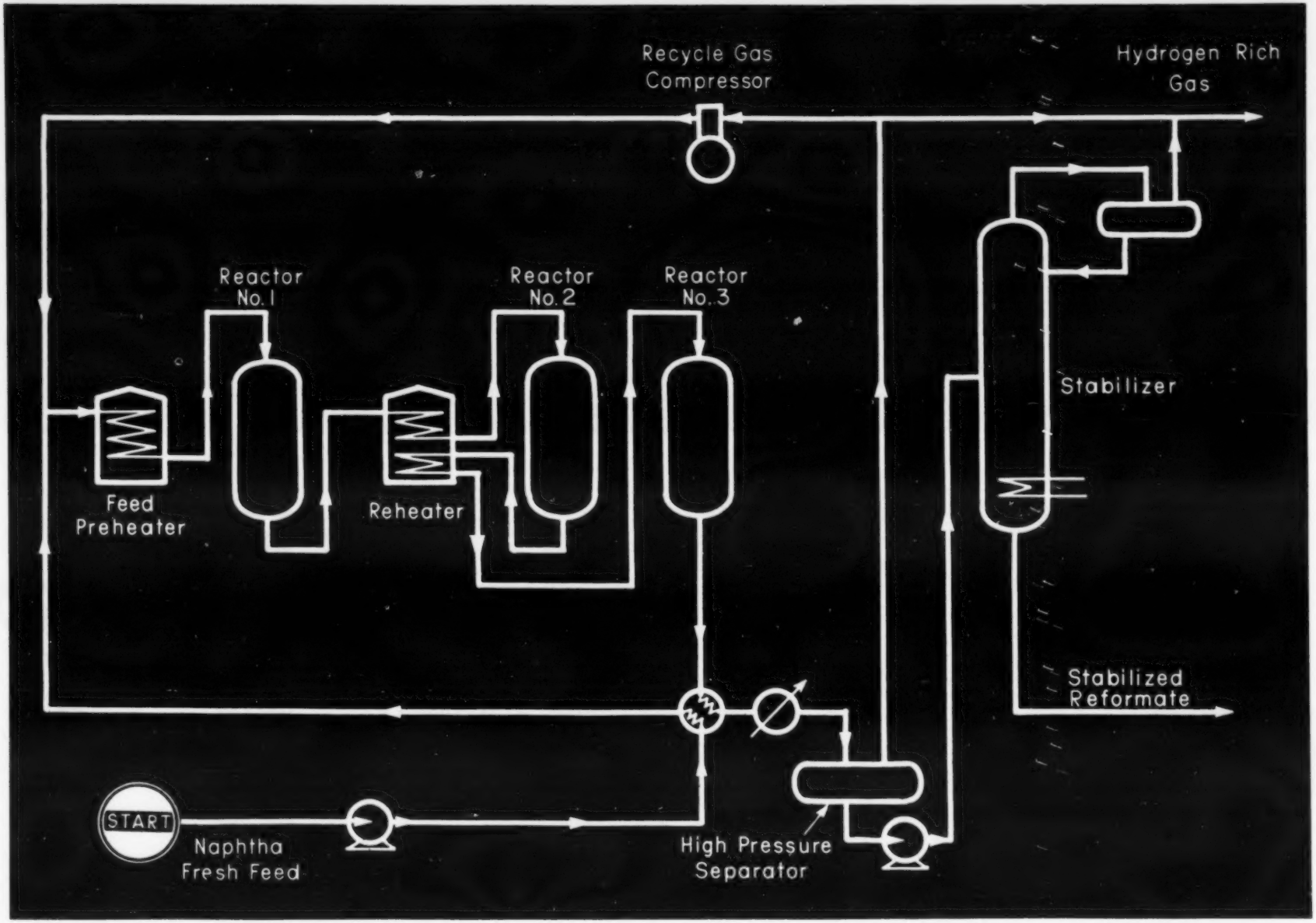
Yields—Typical yields for motor gasoline production are summarized in Table 1 on a variety of charging stocks.

Commercial Installations—Ten Houdriforming units having an aggregate charging capacity of 77,530 barrels per stream day are either in operation or are under engineering and construction. The plants range in size from 1000 to 18,000 barrels per stream day. Three of these plants are currently in operation; an 8330-barrel-per-stream-day unit for motor gasoline production at The Ohio Oil Company's Robinson, Ill. refinery, a 15,000-barrel-per-stream-day unit producing aromatics at Sun Oil Company, Marcus Hook, Pa. refinery, and a 3000-barrel-per-stream-day unit for motor gasoline production at Sun Oil Company Limited's Sarnia, Ontario, Canada refinery. In addition, seven other Houdriforming units (with a total capacity of 51,200 barrels per stream day) are being engineered and constructed.

TABLE 1

Typical Houdriforming Results
Processing Naphthas for Motor Gasoline

CHARGE STOCK TYPE	Venezuela		Mid-Continent		Middle East	
Charge Stock Inspections						
Gravity, °API	52.5		55.3		53.9	
ASTM Distillation						
Initial	178		208		218	
10 Percent	217		243		266	
50 Percent	276		278		310	
90 Percent	358		334		360	
End Point	402		383		398	
Chemical Composition Volume Percent						
Paraffins	43.7		49.9		64.7	
Olefins					0.4	
Naphtheres	37.0		44.7		19.8	
Aromatics	19.3		4.4		15.1	
F-1 Clear Octane	55.7		40.0		26.4	
F-1 + 3 cc TEL Octane	77.3		66.9		47.9	
Debutanized Reformate						
F-1 Clear Octane	86.3	91.7	87.6	93.9	84.6	93.9
F-1 + 3 cc TEL Octane	96.2	99.3	97.0	100.6	95.2	100.6
Yields						
Debut. Gasoline Volume Percent	89.0	84.7	85.9	81.7	83.2	76.4
Butanes, Volume Percent	4.3	5.3	5.5	7.2	8.0	10.9
Dry Gas, Wt. Percent	4.5	6.8	6.4	8.7	8.9	13.0
Hydrogen, Wt. Percent	1.2	1.2	1.2	1.3	0.7	0.8
C_5^+ Houdriformate Inspections						
Gravity °API	48.0	46.2	50.3	49.2	51.1	50.3
Reid Vapor Pressure, psi.	2.9	3.4	3.0	3.6	3.3	3.9
Chemical Analysis (Volume Percent of C_5^+ Houdriformate)						
Paraffin	39	39	45	40	48	40
Olefins	1	1	1	2	2	3
Naphthenes	5	1	1	0	2	0
Aromatics	55	59	53	58	48	57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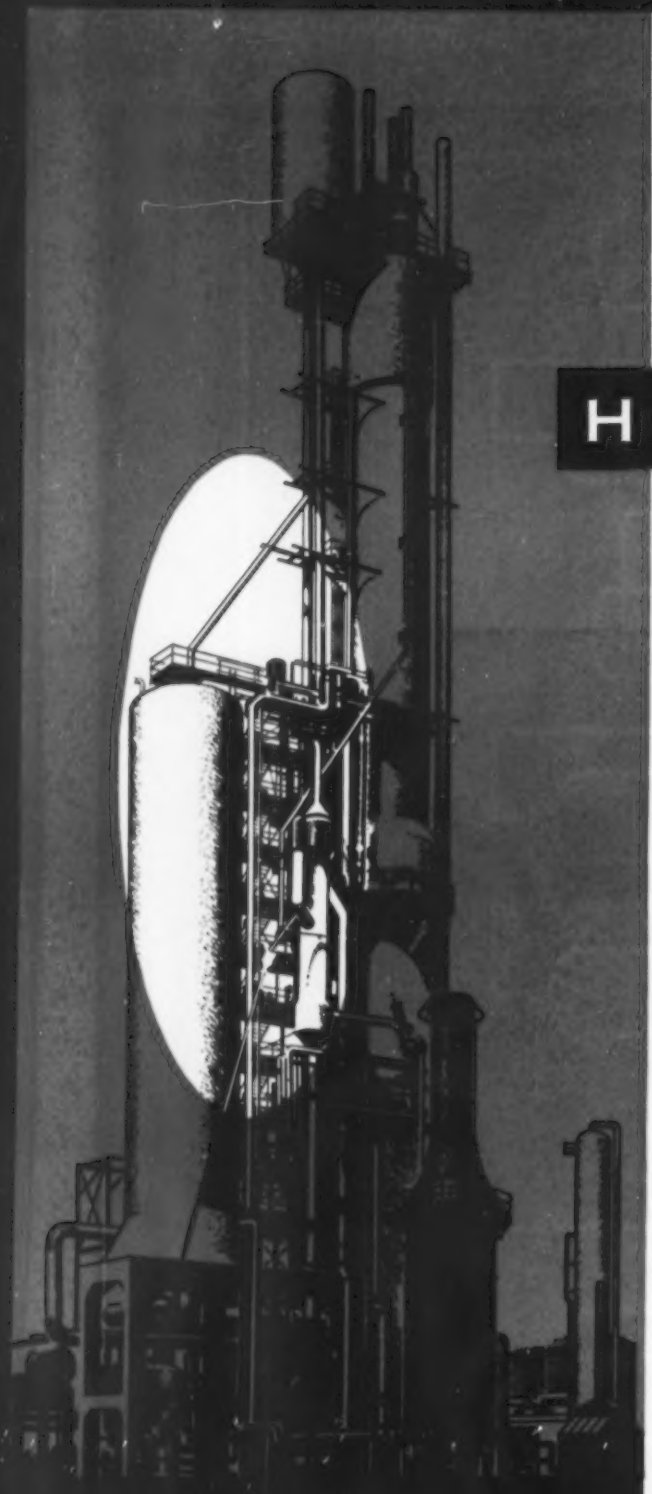
Hydrogen Rich
Gas
Reactor
No. 1
Reactor
No. 2
Reactor
No. 3
Feed
Preheater
Reheater
Stabilizer
Stabilized
Reformate
START
Naphtha
Fresh Feed
High Pressure
Separator



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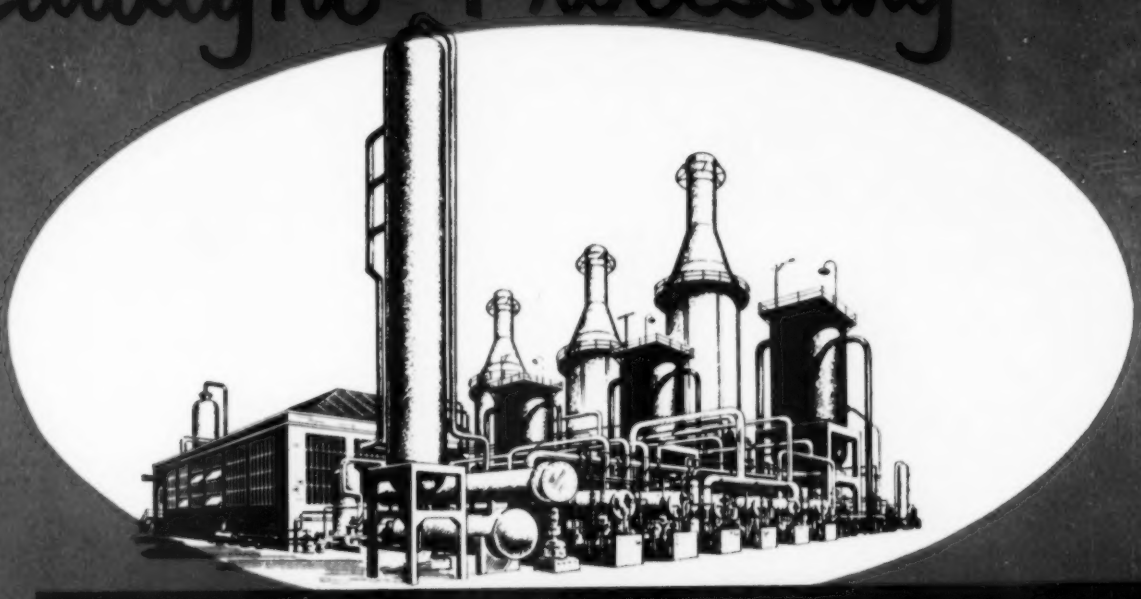
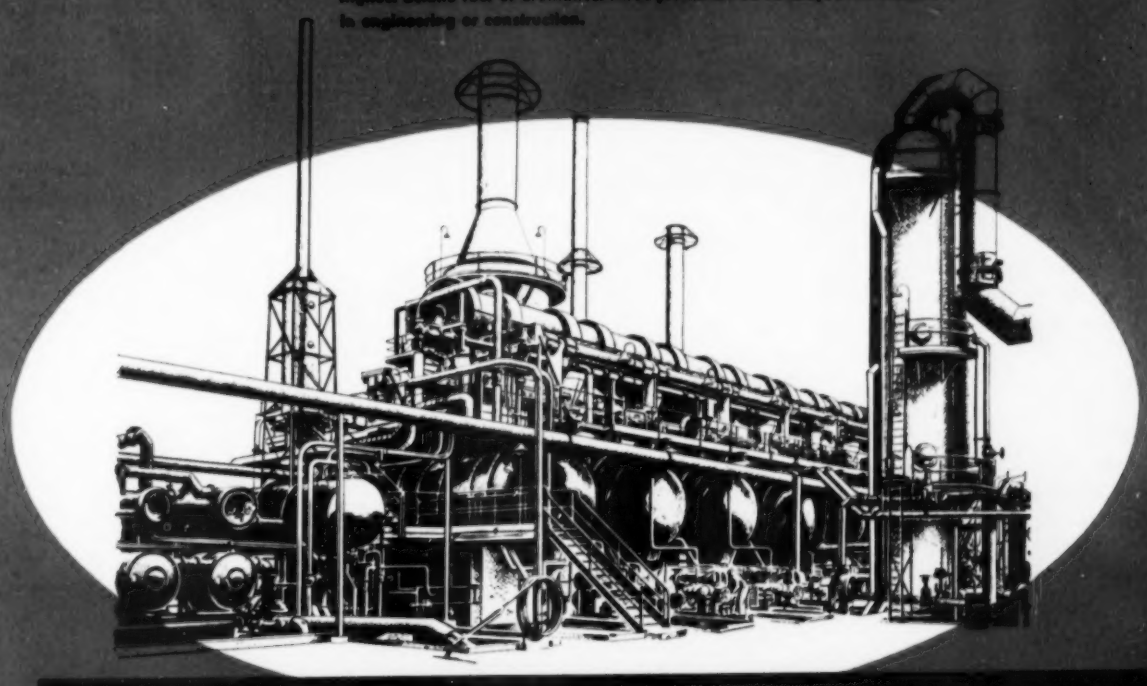


HOUDRIFORMING

Houdriforming Catalytic Reforming process is giving maximum yields of highest octane fuel or aromatics. Three plants are on stream, seven others are in engineering or construction.



HOUDRY DEHYDROGENATION

Houdry Dehydrogenation process is the only commercially-proved single-step process for the production of either butylenes or butadiene from low cost, plentiful butane. This process is adaptable to many other related conversions.

Hyperforming—UNION OIL COMPANY OF CALIFORNIA

Application—Hyperforming is currently applicable to the upgrading of straight-run gasolines and/or straight-run-cracked gasoline mixtures to produce a product essentially free from nitrogen and sulfur, elevated in octane, reduced in boiling range, and gum stable.

Charge—Straight-run and cracked gasoline fractions boiling between 150 and 450 F. may be processed. Since the process incorporates regeneration facilities, there is no critical limitation on charge stock boiling range or octane level of the product.

Description—The Hyperforming process is a continuous regenerative catalytic reforming process which utilizes the new Hyperflow (mass flow) catalyst-handling technique. The catalyst is circulated at very low velocities and virtually no impact by this new Hyperflow lift principle resulting in minimum attrition loss. It carries out the reforming of straight-run naphthas, as well as blends of straight-run and cracked stocks, to effect major uplifts in gasoline quality with high over-all liquid yields.

The reactor utilizes a moving bed of special cobalt molybdate type catalyst. Operating pressure is near 400 psi. A recycle stream of hydrogen is employed to carry out the catalytic reactions, and reactor temperatures are in the range of 800 to 900 F. The reactor incorporates solids-handling features which provide precise control of catalyst motion at all points. The catalyst moves downward through the reactor under gravity flow, and is returned back through the top of the reactor by means of mass conveyance in a catalyst-transfer line. Simultaneous with this vertical lift, regeneration is carried out. The naphtha being processed is heat-exchanged with the reactor effluent and is introduced into the bottom of the reactor at a pressure of approximately 400 psi. The naphtha vapor with the recycle gas flows upward countercurrent to the catalyst, and hot hydrogen is introduced at several interheating points. The naphtha leaves the top of the reactor as a thoroughly refined product. The vapors passing through the preheat exchanger are cooled and the recycle gas and liquid product separated.

Blends of straight-run gasoline and cracked stocks can be refined simultaneously by Hyperforming. In the course of upgrading, the hydrogen released in the dehydrogenation of naphthenes is re-used for the elimination of large quantities of sulfur, nitrogen, and oxygen compounds in inferior stocks. Olefins are saturated as well. This exchange of hydrogen between the straight-run gasoline and the inferior stocks leads to refined gasoline without the requirement of external hydrogen production.

Reactions of the process included the combination of dehydrogenation of naphthenes to aromatics as well as hydrogenation to eliminate gasoline contaminants. Dehydrocyclization of paraffins is a feature leading to high quality products from paraffinic feed stocks. A substantial amount of hydrocracking of the higher molecular weight hydrocarbons occurs together with isomerization of paraffins and naphthenes. Improved volatility of the product is a feature of the operation which increases the potential volume of charge stocks to the reforming plant with a corresponding increase of possible gasoline production from a given refinery installation.

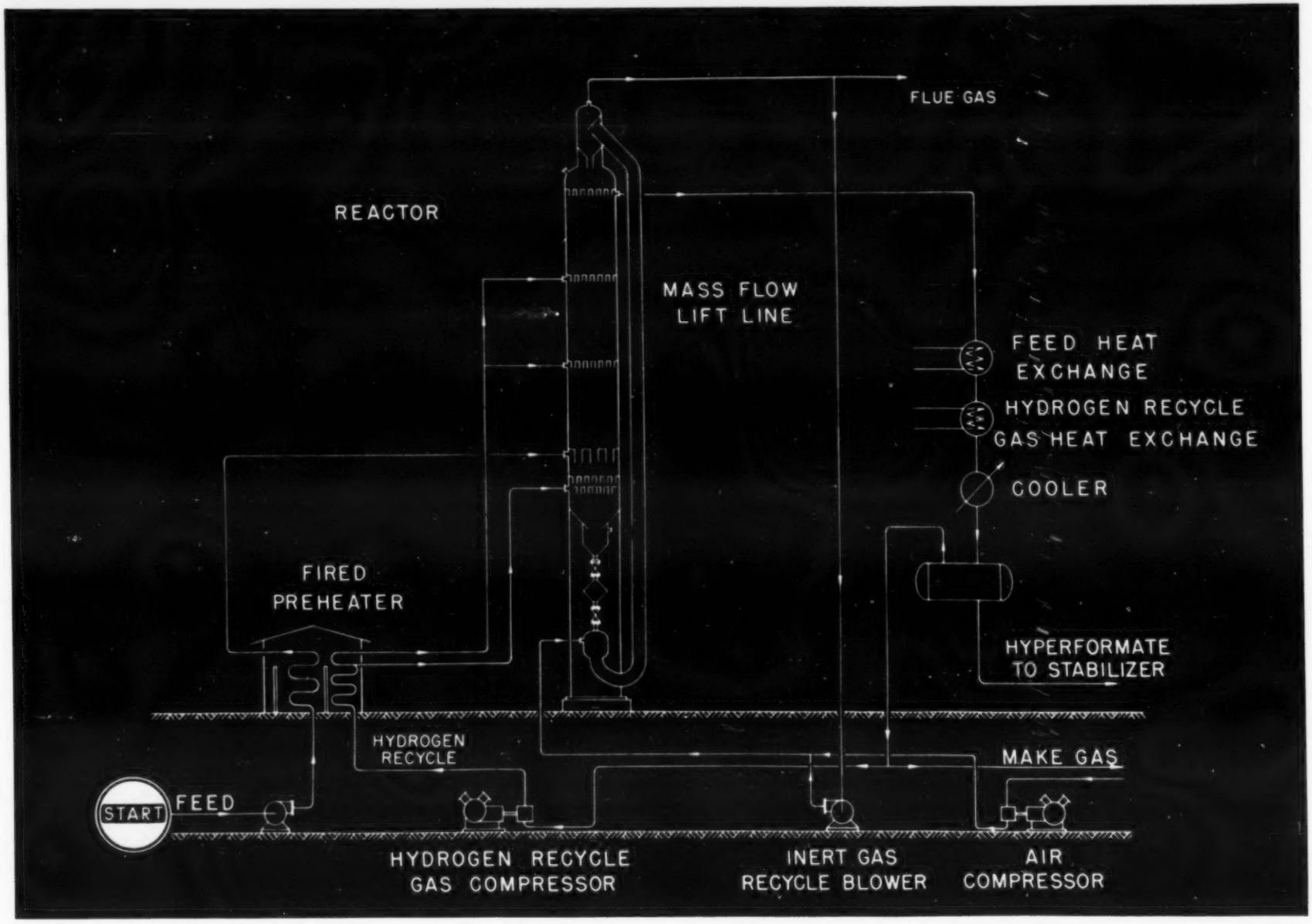
Currently in the development stage is a modification of Hyperforming to permit carrying out in a two-zone reactor system the simultaneous desulfurization and upgrading of a gas oil fraction using the make hydrogen from the reforming zone.

Operating Conditions—Hyperforming is carried out at pressure levels on the order of 400 psi and the reactor temperatures are in the range of 800 to 900 F. Hydrogen recycle is utilized and space velocity is adjusted to the particular characteristics of the stock being processed.

Yields—Typical yields of processing of mid-continent naphtha are shown in the table.

LIQUID PRODUCT DATA	Charge Stock	PRODUCT	
Octane Ratings:			
F-1 Clear	40.0	91	84
F-1 + 3cc TEL	62.5	98	95
F-2 Clear	40.0	81.5	75
F-2 + 3cc TEL	63.0	88.5	86
Gravity, °API	51.6	52.1	52.2
Engler Dist., °F.:			
Initial	256	99	115
10	270	181	209
50	292	272	280
90	340	333	335
95	354	390	370
E.P.	382	417	406
C_4 + Liquid Yield, Volume Percent	....	91.7	93.8
Butane Yield, Volume Percent	....	6.0	4.6
Polymer	....	0.4	0.2

Commercial Installations—The first commercial Hyperforming unit is being installed at the Signal Hill plant of Calstate Refining Company. In this application the plant will process a mixture of viscosity-breaker pressure distillate and straight-run gasoline from Los Angeles Basin crude oil. Simultaneous octane improvement and desulfurization will be effected. The product will be sweet and contain 0.007 percent sulfur, as compared with 0.579 percent sulfur in the feed charge.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LIFT LINE
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EXCHANGE
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FIRED
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TO STABILIZER
HYDROGEN
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Fluor combines process experience with two proven methods to design and build better ammonia plants

Fluor is presently engaged in designing and building four ammonia plants representing a total investment of over $40,000,000. Each plant will use a different raw material: electrolytic and other by-product hydrogen, fuel oil, natural gas, and coke oven by-product gas. There is a wide range of source materials that may be used in ammonia plants designed and built by Fluor.

By special agreement with L'Air Liquide Societé of France, Fluor is using the Claude Process, long recognized as the world's outstanding method of ammonia synthesis. Fluor will draw upon the valuable experience of the Societé which, for 30 years, has developed high pressure techniques to a high degree of perfection while building and operating its own ammonia plants, in addition to building plants for others throughout the world.

Fluor is also licensed to employ the Texaco Partial-Oxidation Process, by far the most advanced means of manufacturing the hydrogen gas from which ammonia is synthesized.

This broad ammonia experience plus Fluor's recognized ability to design and construct processing facilities is your key to a better ammonia plant.

BE SURE WITH

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THE FLUOR CORPORATION, LTD
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BIRMINGHAM
TULSA

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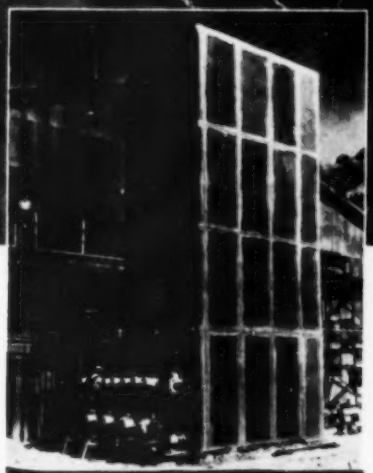
TONNAGE OXYGEN . . . continuous production at lower cost



Stacey Brothers' design pioneered the use of welded-aluminum construction for all low temperature parts . . . utilizes modern-design reversing exchangers for efficient "no-shut-down" operation . . . requires no chemicals . . . needs only minimum operating crew.

Turn first to Stacey Brothers when you need a tonnage oxygen plant with long-time low costs of operation and maintenance. Take full advantage of Stacey's specialized experience in design, engineering, fabrication, construction . . . all the way thru to final Acceptance Testing.

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Write for Bulletin 0-50, **the complete story about Stacey Brothers oxygen plants. *Standard Designs are* ready for plants producing 10 to 50 tons per day.**

All-Aluminum low temperature parts remain ductile, increase in tensile strength at sub-zero temperatures, have high thermal conductivity . . . welded joints insure against leakage.

Reversing Exchanger Design permits economical continuous operation . . . no shut-downs for de-riming.

For more data on advertised products, use Readers' Service Cards, last page.

Platforming—UNIVERSAL OIL PRODUCTS COMPANY

Application—Platforming has three principal applications: (1) to upgrade low-octane naphthas to premium quality motor fuels, (2) to produce high yields of aromatic hydrocarbons from select naphtha cuts, and (3) to produce high-quality aviation gasoline components.

Charge—For motor fuel operation; straight run and/or cracked naphthas boiling in the range of 150-400 F. For aromatics or avgas operations; selected straight run naphtha fractions.

Products—Motor fuel operation: Typical product is stable, requires no rerunning, and can be produced at any desired quality to fit marketing requirements.

Aromatics operation: Product contains benzene, toluene, xylenes, and other aromatics. The charge stock boiling range and operating plant conditions are adjusted to maximize the production of the desired individual aromatics. The product from the Platformer operation consists of a mixture of the various aromatics with non-aromatic hydrocarbons of about the same boiling range. The production of individual aromatics from the Platformate is accomplished by use of a type separation process, such as Udex extraction, followed by separation of the individual aromatics by distillation. This combination of processes results in the production of individual aromatics of extremely high purity.

Description—The accompanying flow diagram depicts a typical Platforming unit. The unit may generally be divided into three sections; the reactor-heater section in which the charge plus recycle gas is heated and passed over the catalyst where the reaction takes place; the separation and compression in which the reactor effluent is separated into gas and liquid streams, the gas being compressed for recycling; and the stabilization section in which the separator liquid is stabilized to the desired vapor pressure.

Depending upon the character of the feed stock, it may be desirable to add a fourth section for pretreatment of the feed to remove undesirable components contained therein, or a recycle gas scrubbing system to remove H_2S from the gas. The Unifining process has proved valuable as a means of producing satisfactory feed stocks from otherwise unsuitable materials.

The feed-preparation section consists of a fractionation column taking material boiling in the gasoline range and removing overhead any light gasoline that need not be charged to the reaction zone by virtue of its high octane number. A small amount of bottoms is removed to prevent high boiling materials from reaching the catalyst. The reactor charge is drawn from the column as a sidecut. In many cases, existing facilities permit use of a simpler feed preparation system.

The reactor section consists of preheaters for the reactor feed and recycle gas, beds of catalyst, intermediate heaters between catalyst beds, heat exchangers, a product separator drum, and a recycle gas compressor. Catalyst is divided into several beds in series depending on the severity of the operation and on the type of feed stock, with interheating between beds of catalyst, as the over-all reaction is endothermic. Reactor feed stock from the feed-preparation section is pumped to the naphtha heater for preheating to reaction temperature.

At the inlet to the feed pretreater, the recycle gas joins with the naphtha. The reactants are reheated between the catalyst beds by an intermediate heater or heaters. After heat exchange, the reaction products flow to a separator drum from which the recycle gas compressor takes suction. The net make of gas is vented from the system. This gas which consists largely of hydrogen is available at elevated pressure, and is a valuable by-product of the process and may be used for the purification of various fractions in the refinery by hydrorefining processes such as Unifining. In some cases, this hydrogen is used for other chemical purposes such as, for example, the production of ammonia. When not used in these ways, the excess hydrogen is used for refinery fuel. Liquid product from the separator drum passes to a stabilizer for preparation of finished gasoline.

The stabilization section consists of a high-pressure stabilizer for production of a finished gasoline of desired vapor pressure from the bottom of the column. Gas from the stabilizer reflux drum enters either the absorption system or the fuel system as is desired. No rerunning of the stabilizer bottoms is necessary since no high-boiling products are made.

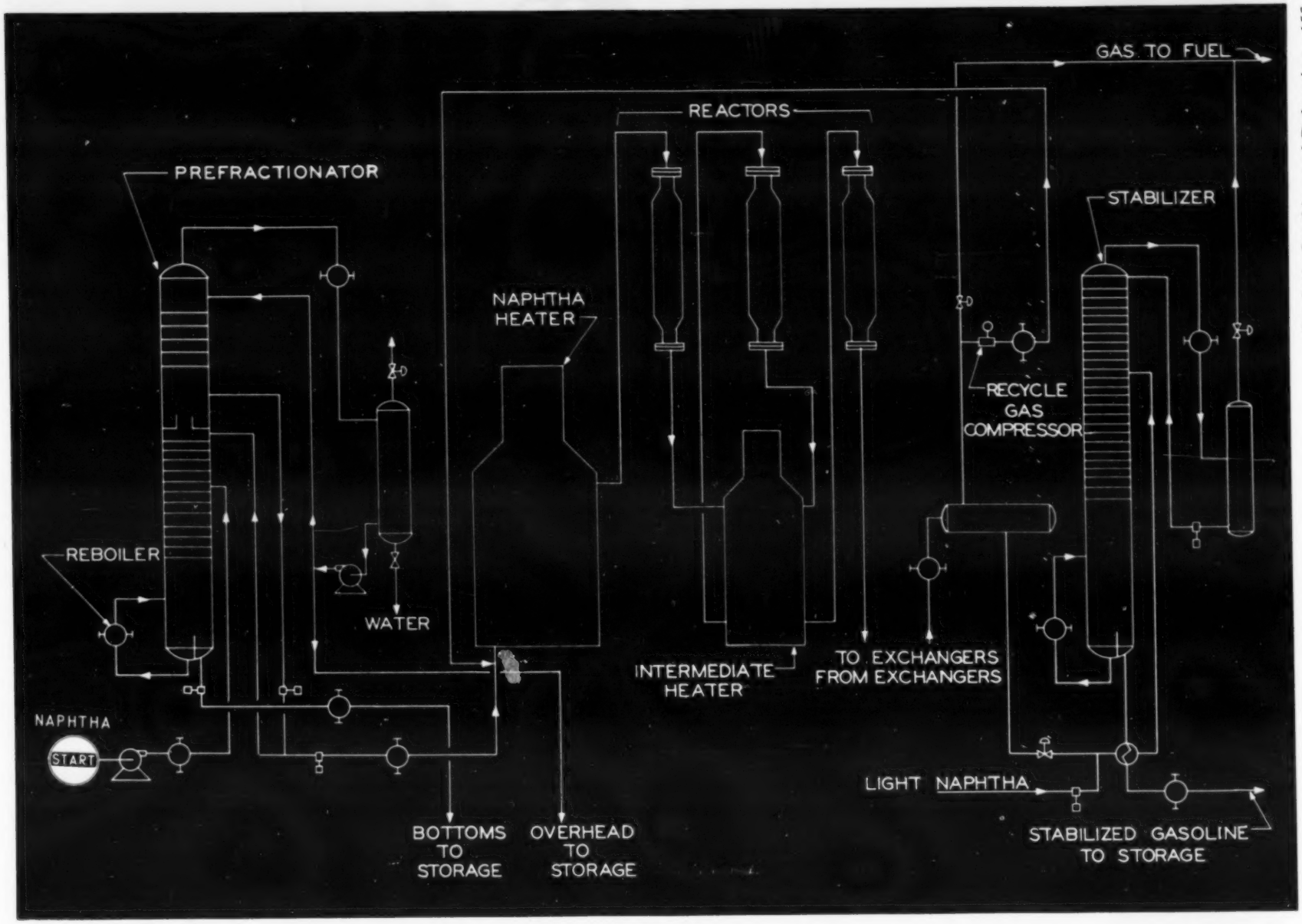
The prinicpal chemical reactions involved are dehydrogenation of naphthenes to aromatics, hydrocracking of high molecular-weight paraffins to lower-molecular weight paraffins, isomerization of paraffins and of naphthenes, dehydrocyclization of paraffins, and desulfurization of sulfur compounds, forming hydrogen sulfide.

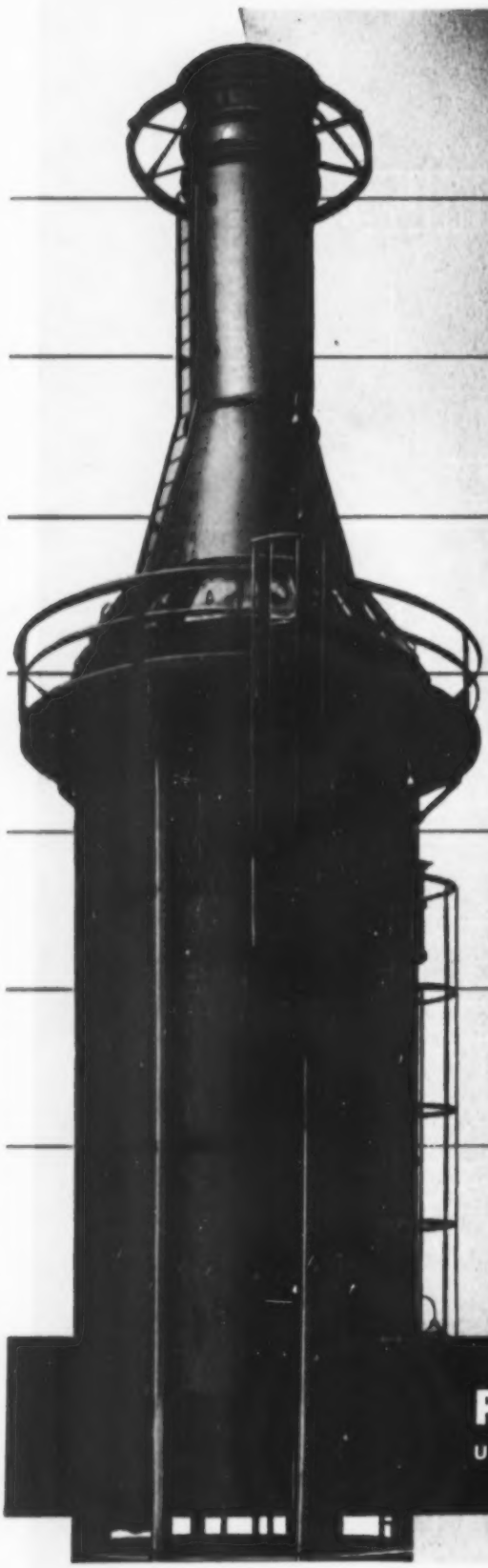
Operating Conditions—The four major process variables are temperature, space velocity, pressure and hydrogen recycle rate. The reactor temperature is normally in the range of 850-980 F. when operating at pressures from 200-800 psig.

Yields—Typical yields when operating on a Mid-Continent naphtha at several different operating conditions are shown below.

	Charge Stock	Platformates		
Yield of 10 lb. RVP Plat., L. V. Percent of Charge	.....	101.0	96.8	89.3
Extraneous C_4 Req. to 10 lb. RVP, L.V. Percent of Charge	...	8.2	6.2	1.8
RVP	0.2	10.0	10.0	10.0
Octane Ratings:				
F-1 Clear	32.4	85.0	90.0	95.0
+ 3cc TEL Gallon	56.4	95.5	98.5	isoC$_5$ + 0.12cc
Percent Sulfur	0.04	.....	.....	.....
Molecular Weight	128	.....	.....	.....
UOP "K"	11.93	.....	.....	.....
Debutanized Basis:				
°API	52.6	48.0	46.8	44.8
100 Ml. Dist.:				
IBP, °F	230	144	140	132
10 Percent	255	200	191	173
50 Percent	308	285	281	272
90 Percent	372	366	366	365
95 Percent	382	384	386	389
EP	397	410	412	413

Commercial Installations—Platforming is the pioneer catalytic reforming process employing a platinum-containing catalyst. Units from 600 to 16,000 barrels per stream day are in commercial operation. Others, ranging up to 29,000 barrels per stream day, are in various design or construction stages.


GAS TO FUEL
REACTORS
PREFRACTIONATOR
STABILIZER
NAPHTHA HEATER
RECYCLE GAS COMPRESSOR
REBOILER
WATER
INTERMEDIATE HEATER
TO EXCHANGERS
FROM EXCHANGERS
NAPHTHA
START
LIGHT NAPHTHA
BOTTOMS TO STORAGE
OVERHEAD TO STORAGE
STABILIZED GASOLINE TO STORAGE



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installed by 62 Chemical Manufacturers

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UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

There's no better testimony to customer satisfaction than

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Repeat orders for Petrochem-Isoflow Furnaces prove their unique technological features are best by any comparison:

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uniform heat distribution • minimum ground space
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plenum chambers for hazardous areas

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low maintenance • zero air leakage
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PETROCHEM-ISOFLOW FURNACES ARE BEST BY ANY COMPARISON

More than 1200 are in operation throughout the world in the petroleum, chemical and allied industries... for all processes and for any duty, pressure, temperature and efficiency... and all Petrochem-Isoflow Furnaces are pre-eminently satisfactory.

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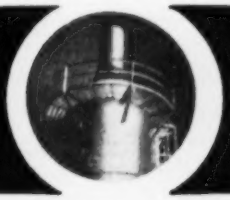

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Thermofor Catalytic Reforming—SOCONY-VACUUM OIL COMPANY, INC.

Application—Thermofor Catalytic Reforming (TCR) is used to produce high octane gasoline products for motor and aviation purposes.

Charge—The charge to TCR units is low octane, gasoline-boiling hydrocarbon fractions, including, if desired, thermally-cracked gasolines.

Product—The TCR product is gasoline of very low sulfur content, generally having octanes in the 100 F-1, leaded, range.

Description of Process—Referring to the accompanying flow diagram, the naphtha charge flows down through an absorber to attain the desired recovery of light hydrocarbons from the product. The enriched charge is then heat exchanged against reactor effluent and heated to about 900 F., and charged to the reactor with recycle gas. The TCR reactor contains a compact, moving bed of catalyst and is fed in the center. The effluent products from the top and bottom are combined; cooled by heat exchange against recycle gas and rich naphtha, and by generating steam; depolymerized; and then water cooled before flashing. The flashed gas is compressed and recontacted with the primary condensate, cooled and reflashed. This secondary off gas forms the recycle stream, with the net make flowing to the absorber for recovery. The absorber off gas is then sent to the refinery fuel system. The recycle gas may be dried, and is heat exchanged before being reheated and fed to the reactor. The depolymerization step is merely flashing under reduced pressure to eliminate a small amount of polymer. The polymer (boiling between 400 and 500 F.) is highly aromatic. The secondary condensate is charged to a depropanizer, producing more fuel gas overhead, and high octane gasoline bottoms. Besides the reactor the catalytic section of the TCR unit contains the kiln, catalyst elevating system, a catalyst pressure lock system going into the reactor, and storage bins. The kiln is similar to those of the bucket-type TCC units built prior to the development of the Socony Air-Lift TCC unit design, and contains alternate burning and cooling sections, operating at atmospheric pressure. The elevating system may be of any type, but since catalyst circulation rates are small, (only four tons per hour for a 3500-barrel-per-stream-day unit) units under construction are designed with bucket elevators. Since the kiln is operated at atmospheric pressure and the reactor at about 175 psig, a pressure lock system is used for introducing catalyst into the reactor. The low catalyst circulation rate permits this system to be quite simple in design. The catalyst is a chromia-alumina bead, similar in appearance to the Socony bead cracking catalyst used in TCC units. The reforming conditions are adjusted to deposit a certain amount of coke per cycle on the catalyst, so that there is no actual limit on the depth or severity of reforming. Essentially all the sulfur in the feed is converted to hydrogen sulfide, which can be recovered from the reactor gas, if desired.

Operating Conditions—As noted above, the reactor pressure is usually about 175 psig, but may be varied between, for example, 100 and 200 psig, for best results on different stocks. The gas recycle ratio is usually set at about 6 moles (3 of hydrogen) per mole of naphtha, although it may be varied for various stocks. The space velocity is usually set as 0.7 volumes of naphtha per hour per volume of reaction bed, but this variable can be used interchangeably with reactor temperature to attain desired octanes. The reactor temperature depends on the stock, the severity, and the space velocity, but is usually about 950 F. The catalyst circulation rate will have little effect on yield or quality, and is usually controlled so that the coke deposit on the catalyst is about 4 percent weight per cycle.

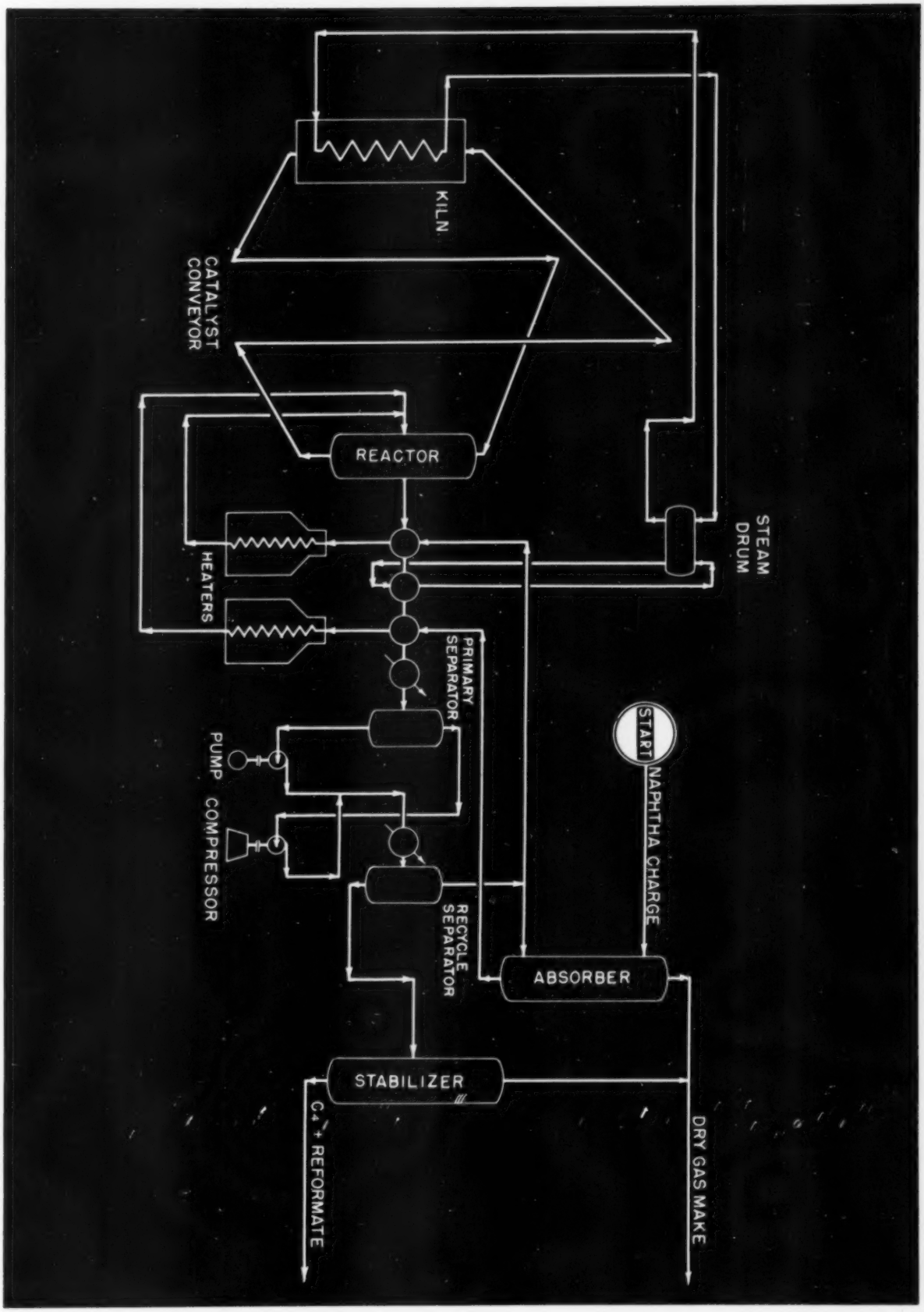
Yields—The example of TCR yields below is illustrative of the desulfurization attained by Thermofor Catalytic Reforming. The charge was a 225 to 400 F. blend of straight run and coker naphthas from Wilmington (California) crude.

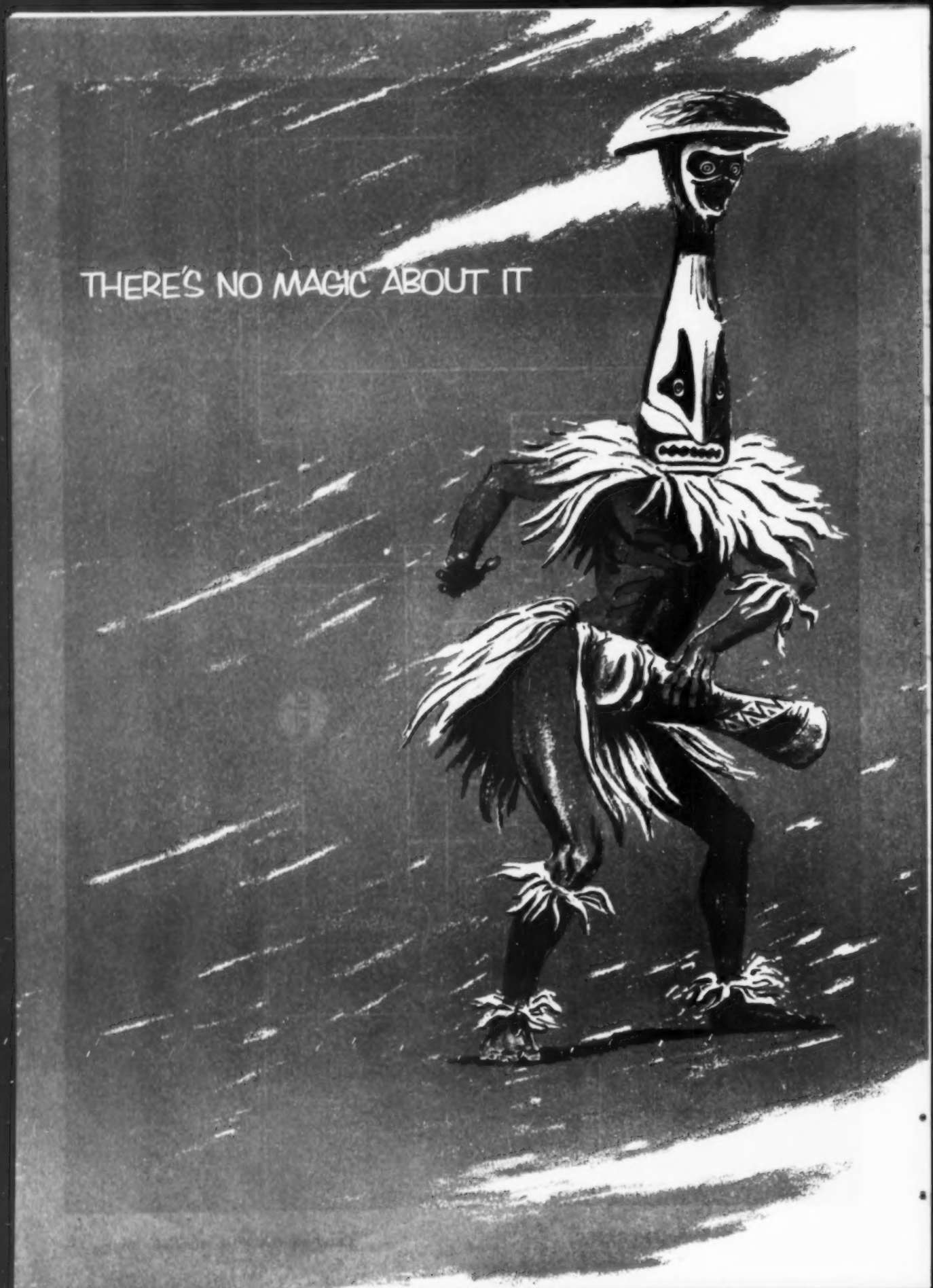
	Charge	10# Reformate
% Vol. Charge	100.0	94.0
Gravity, °API	46.3	49.8
Norwood Bromine No.	36.7	13.5
Sulfur, % weight	0.59	0.014
Research Octanes		
Clear	65.2	89.3
+ 3 cc TEL	75.4	97.9

This operation resulted in a deficiency of 6.1 percent volume charge butane for 10-pound RVP reformate, and produced 10.0 percent weight of propane and lighter gas, and 1.4 percent weight coke.

Commercial Installations—The Socony TCR units now under construction are listed below:

Company	Location	Capacity B/SD
General Petroleum Corp.	Torrance, Calif.	19,000
Magnolia Petroleum Co.	Beaumont, Texas	19,000


KILN
CATALYST CONVEYOR
REACTOR
STEAM DRUM
HEATERS
PRIMARY SEPARATOR
START
NAPHTHA CHARGE
PUMP
COMPRESSOR
RECYCLE SEPARATOR
ABSORBER
STABILIZER
C4 + REFORMATE
DRY GAS MAKE


THERE'S NO MAGIC ABOUT IT

NOR IS THERE ANY MAGIC in saving time on even the most complicated process construction job when it's in the hands of qualified men . . . Procon men.

Saving time is the logical result of a combination of factors . . . careful planning at the outset . . . engineering competence . . . broad experience that insures quick decisions, and right ones . . . proper coordination of all duties . . . a thorough knowledge and understanding of every operation involved . . . a willing acceptance of responsibilities . . . plus a sincere desire to make every hour productive to the fullest extent.

These are Procon's standards, and while the time saved will be of great value to you, it will cost you nothing extra . . . another important reason for entrusting your next process construction job to Procon.

PROCON *Incorporated*

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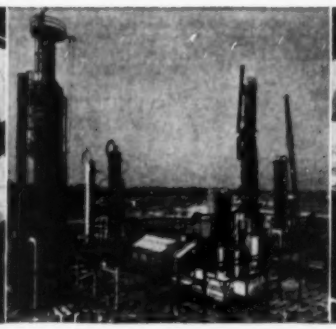
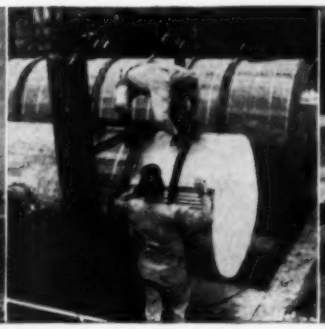



Ultraforming—STANDARD OIL COMPANY (INDIANA)

Application—Ultraforming is a new catalytic reforming process for upgrading low-octane naphthas to high-octane motor gasolines, for producing high-octane components for aviation gasoline, and for producing high yeilds of aromatics for petrochemicals.

Charge—For motor-fuel production, either straight-run naphthas or mixtures of straight-run and cracked naphthas may be charged. Because the process has regeneration facilities, boiling range of the charge stock is not critical. Both highly paraffinic and highly naphthenic naphthas can be economically upgraded.

For avgas or aromatics operations, selected fractions of straight-run naphtha may be processed.

Product—Typical motor-fuel operation gives reformate of 90-100 Research octane number, clear. Avgas or aromatics production gives high yields of benzene, toluene, xylenes, and other aromatics.

Description—Ultraforming is a low-pressure process using an improved platinum catalyst in fixed beds. These beds are regenerated cyclically by a novel technique that completely restores the catalyst to its initial activity. The cycles vary from 1 week to a few months depending upon the severity of the operation. The use of a spare or swing reactor permits cyclic regeneration without interrupting reforming operations.

In the accompanying flow diagram, catalyst in the swing reactor is being regenerated while naphtha is being processed in the other three reactors. Naphtha charge and hydrogen-rich recycle gas are passed through a furnace where they are heated to reactor inlet temperature. They are then passed through three reactors in series. The predominant reactions are endothermic and cause a temperature drop across each reactor. Furnaces are therefore installed between the reactor to reheat the mixture. Effluent from the final reactor is condensed and separated into a liquid stream and a hydrogen-rich gas. The liquid is stabilized to the desired vapor pressure and withdrawn as finished reformate. Part of the gas is recycled: the rest can be used as a source of hydrogen for other processes or as fuel.

When catalyst activity in a reactor declines, that reactor is temporarily isolated from the naphtha-processing system and is replaced by the swing reactor. Naphtha processing continues while catalyst in the isolated reactor is regenerated with air and inert gas. After regeneration, the reactor is placed back on stream and the swing reactor is held in readiness until catalyst in another reactor needs regeneration. Ultraforming catalyst is supplied by American Cyanamid Company.

Low-pressure operation which is made possible by cyclic regeneration, has several major advantages over conventional platinum-catalyst operation: higher gasoline yields, higher ceiling octane numbers, higher effective catalyst activity, and greater flexibility. In addition, low pressure gives higher yields of by-product hydrogen. Furthermore, because the Ultraforming regeneration technique fully restores catalyst activity, the Ultraforming process permits a wide range of operating conditions, recovery from operating upsets, and the use of charge stocks varying widely in character. If excessive coke forms on the catalyst for any reason, the catalyst can be regenerated completely to restore operations to normal.

Operating Conditions—Ultraforming is usually carried out at a reactor pressure of 200-300 psi and a reactor-inlet temperature of 900-950 F. Hydrogen recycle rate and space velocity are adjusted to the particular characteristics of the charge and to the product desired.

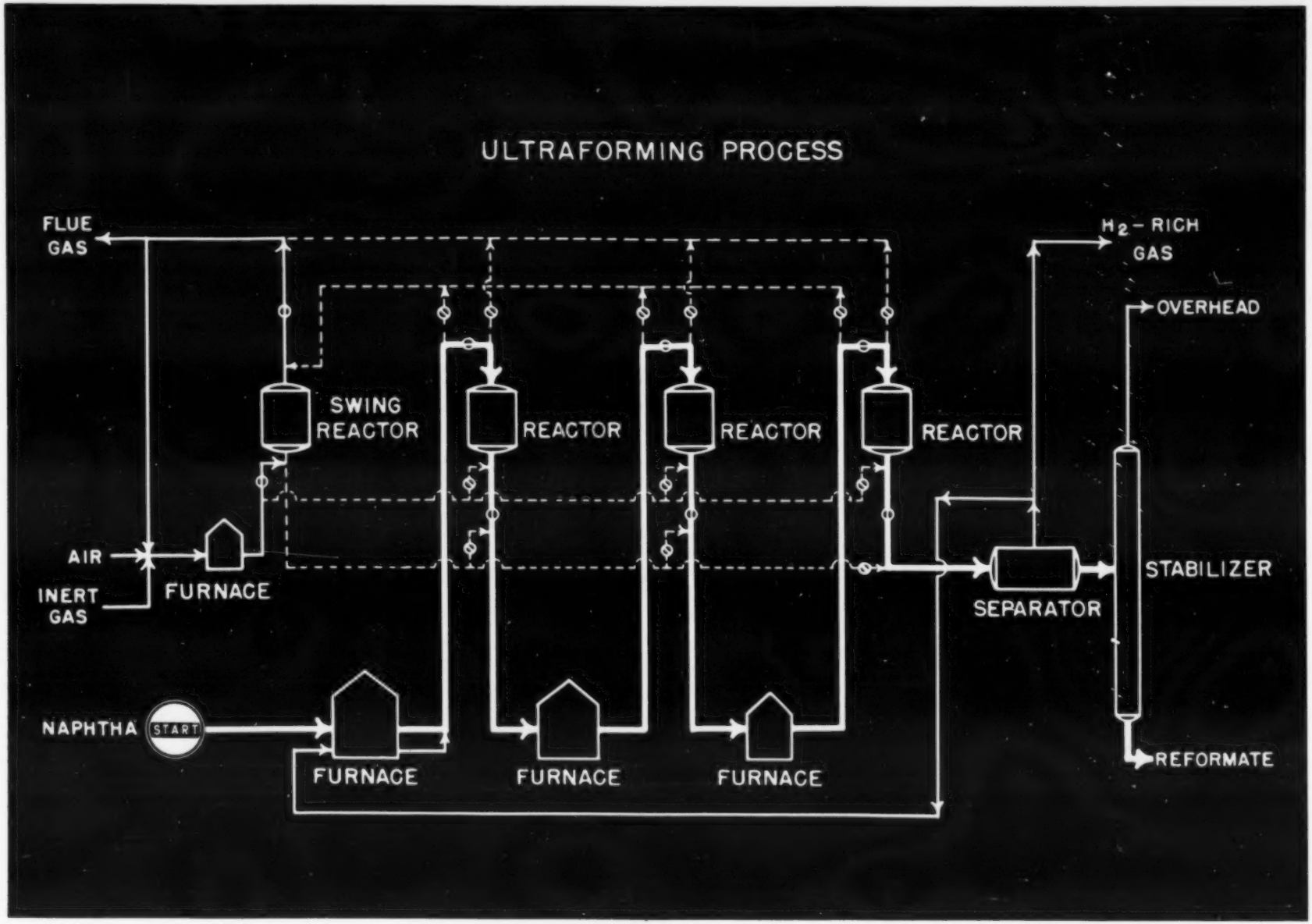
Yields—Ultraforming yields from Gulf Coast and Mid-Continent naphtha at 300 psi are shown in Table 1.

Commercial Installations—Nine Ultraformers are either operating or under design and construction:

Company	Location	Design Capacity, BPD
Pan-Am Southern Corp.	El Dorado, Ark.	6,200
Standard Oil Company (Indiana)	Wood River, Ill.	9,000
Standard Oil Company (Indiana)	Casper, Wyo.	3,700
Standard Oil Company (Indiana)	Sugar Creek, Mo.	14,000
Standard Oil Company (Indiana)	Mandan, N. D.	3,700
Pan American Refining Corp.	Texas City, Texas	21,000
Canadian Petrofina, Ltd.	Montreal, Canada	3,600
Humble Oil & Refining Company	Baytown, Texas	30,000
Great Northern Oil Company	Pine Bend, Minn.	5,300

TABLE 1

CHARGE	Gulf Coast		Mid-Continent	
ASTM Distillation, °F.				
Initial	202		206	
10 Percent	250		237	
50 Percent	305		274	
90 Percent	356		324	
End Point	394		361	
Composition, Volume Percent				
Paraffins	26.0		50.0	
Naphthenes	55.5		41.5	
Aromatics	18.5		8.5	
Octane No., Research, Clear	59.4		44.5	
Products				
C_5 + Reformate				
Octane No., Research, Clear	90	100	85	95
Yield, Volume Percent	91.8	83.8	89.9	82.8
Reid Vapor Pressure	2.0	3.3	2.4	2.8
Butanes, Volume Percent	2.7	6.2	3.1	5.5
Dry Gas, Weight Percent	3.4	7.2	4.8	8.4
Hydrogen, SCF/B	900	1100	970	1150
10-lb. Gasoline				
Octane No., Research, Clear	90	100	85	95
Yield, Volume Percent	105.7	93.2	103.1	93.3


ULTRAFORMING PROCESS
FLUE GAS
H_2 – RICH GAS
OVERHEAD
SWING REACTOR
REACTOR
REACTOR
REACTOR
AIR
INERT GAS
FURNACE
SEPARATOR
STABILIZER
NAPHTHA
START
FURNACE
FURNACE
FURNACE
REFORMATE

DUAL METAL

What is "dual metal"? *Depends on what business you're in!*

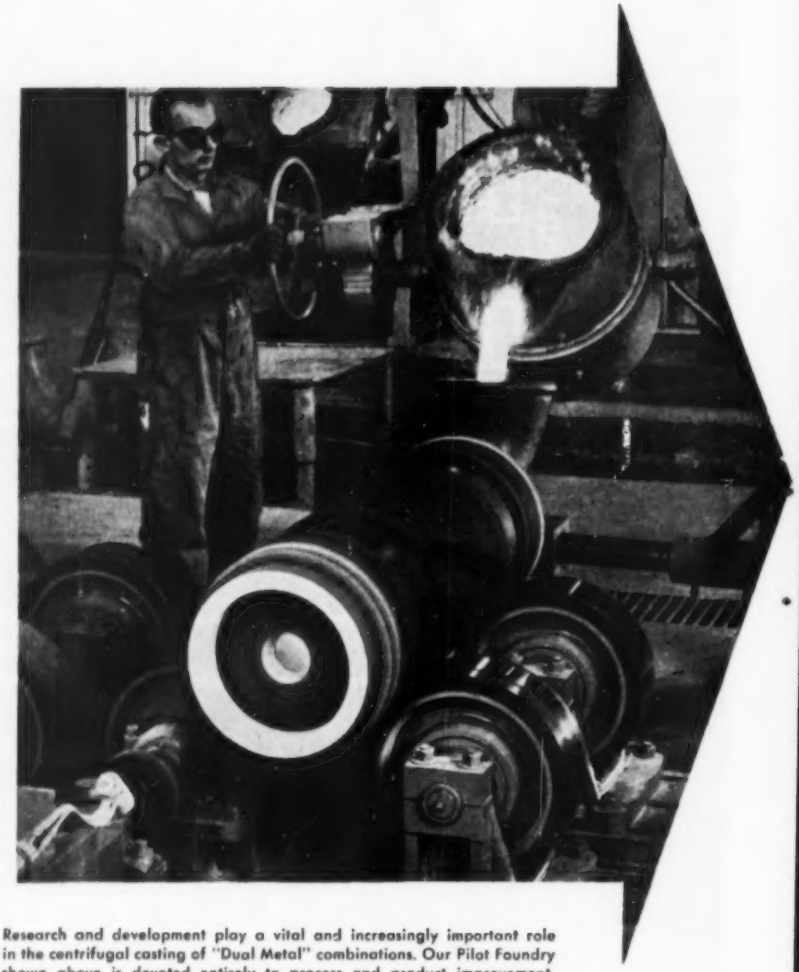
To twenty of America's largest basic industries with problems of abrasion or corrosion—or both—"Dual Metal" means U. S. Pipe's Special Products Division.

Specifically, "Dual Metal" is our name for centrifugally cast cylindrical sections in which two dissimilar metals are bonded metallurgically by centrifugal force and temperature.

"Dual Metal" centrifugally cast, integrally fused combinations of two dissimilar metals are doing industry's most difficult and exacting jobs better and more economically than ever before.

Design engineers have been quick to recognize the outstanding merits of a process capable of combining the desired mechanical and chemical properties no single metal possesses.

"Dual Metal" means versatility, efficiency and economy.



Research and development play a vital and increasingly important role in the centrifugal casting of "Dual Metal" combinations. Our Pilot Foundry shown above is devoted entirely to process and product improvement.

UNITED STATES PIPE & FOUNDRY CO.

Special Products Division

BURLINGTON, NEW JERSEY

SPECIAL PRODUCTS DIVISION U S P

NEW ANSWER TO AN OLD REFINING PROBLEM

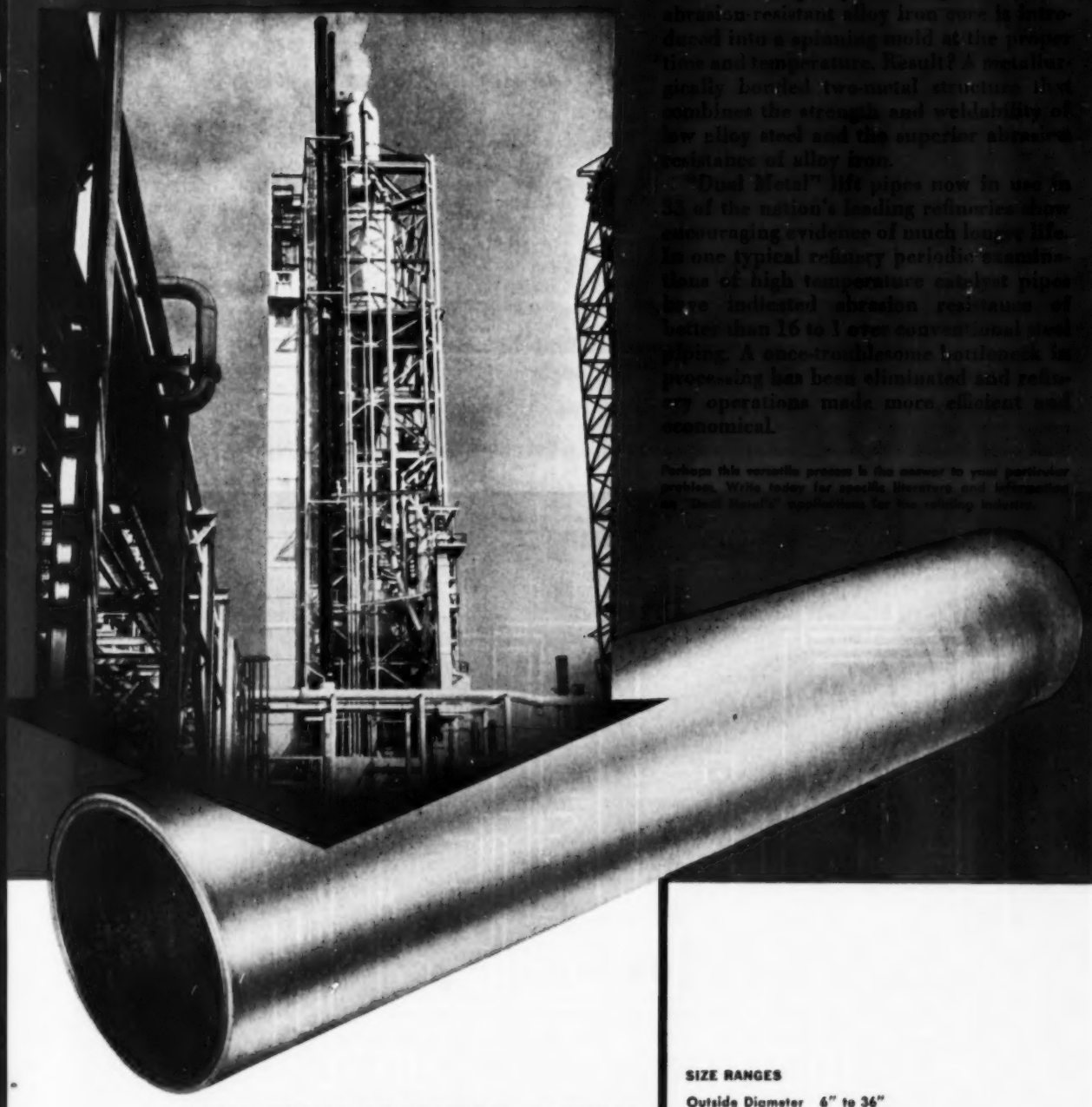
less abrasion...longer wear

"Dual Metal" solves one of the petroleum industry's most severe and costly problems—catalyst erosion of lift pipe and catalyst handling lines.

In making a "Dual Metal" lift pipe the outer shell of weldable alloy steel is poured into a rapidly rotating mold. The abrasion-resistant alloy iron core is introduced into a spinning mold at the proper time and temperature. Result? A metallurgically bonded two-metal structure that combines the strength and weldability of low alloy steel and the superior abrasion resistance of alloy iron.

"Dual Metal" lift pipes now in use in 33 of the nation's leading refineries show encouraging evidence of much longer life. In one typical refinery periodic examinations of high temperature catalyst pipes have indicated abrasion resistance of better than 16 to 1 over conventional steel piping. A once-troublesome bottleneck in processing has been eliminated and refinery operations made more efficient and economical.

Perhaps this versatile process is the answer to your particular problem. Write today for specific literature and information on "Dual Metal" applications for the refining industry.



"DUAL METAL" CENTRIFUGAL CASTINGS

SIZE RANGES

Outside Diameter	6" to 36"
Wall Thickness	½" and up
Length	Up to 14' without welding

Typical Oil Industry Applications: Catalyst Lift Pipe, Depressurizing Pipe, Catalyst Transfer Lines, Slush Pump Liners, Valve Nozzles, etc.

Combination Cracking—THE LUMMUS COMPANY

Application—The process is applied to the segregation of cracking stocks and their independent selective cracking under optimum conditions.

Charge—Crude oil.

Product—Stabilized gasoline, fuel oil and kerosine.

Description—The accompanying process flow diagram is for a modern combination unit employing three cracking heaters, a crude heater, and a five tower fractionating system. This unit is designed to process 14,000 bpd of 38° API crude oil. The operating conditions for processing of this specific stock and the products obtained are shown on the diagram.

The crude charge is preheated to suitable temperature for distillation by heat exchange with cracking process streams and the crude heater. In the crude flash tower the kerosine is fractionated and the naphtha is removed for reforming. The topped crude less fuel oil is mildly cracked in a viscosity breaking step and the clean gas oil is thermally cracked.

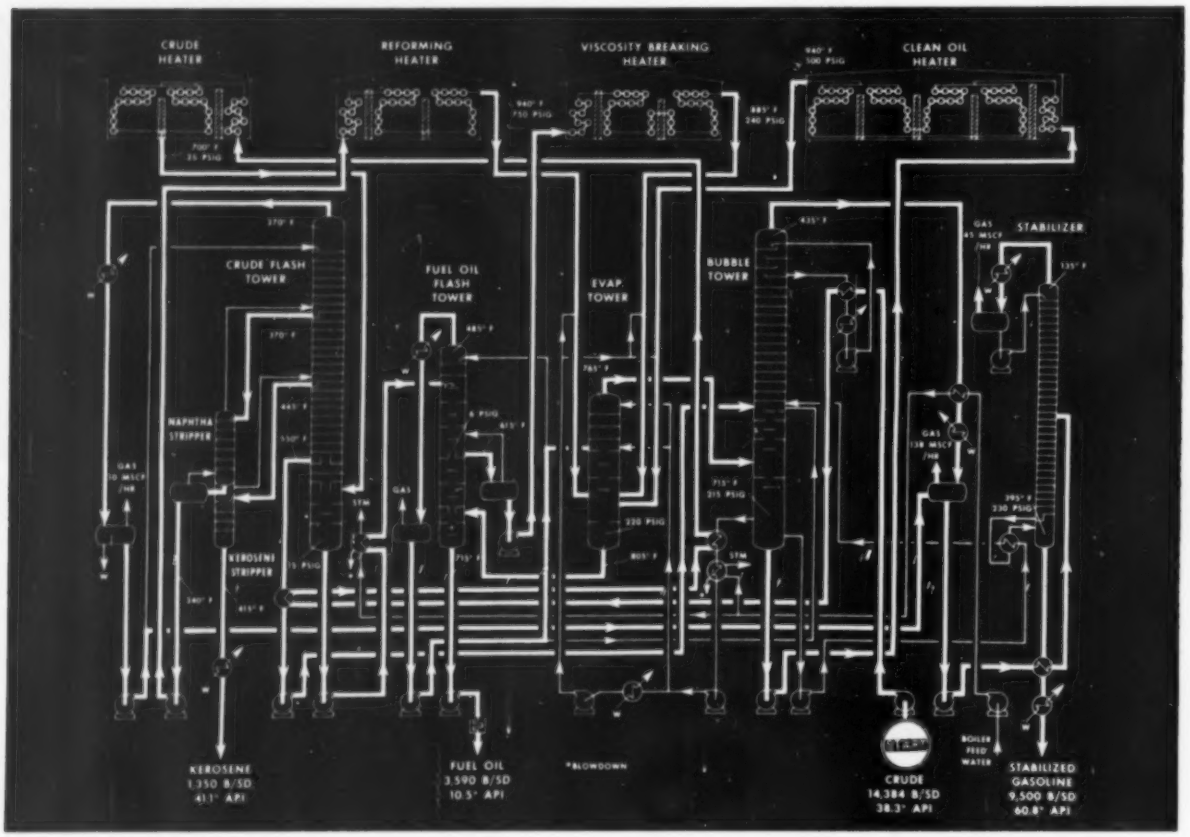
To design for optimum cracking conditions for each stock, independent control of the heating and soaking conditions must be provided. Hence cracking is made selective by employing several cracking coils, each having separately fired heating and soaking chambers in the furnace settings. Another factor which is considered in the heater design of these units to insure and provide an unusual degree of operating flexibility is a uniform rate of heat transfer which will maintain a satisfactory degree of temperature control resulting in minimum coke formation.

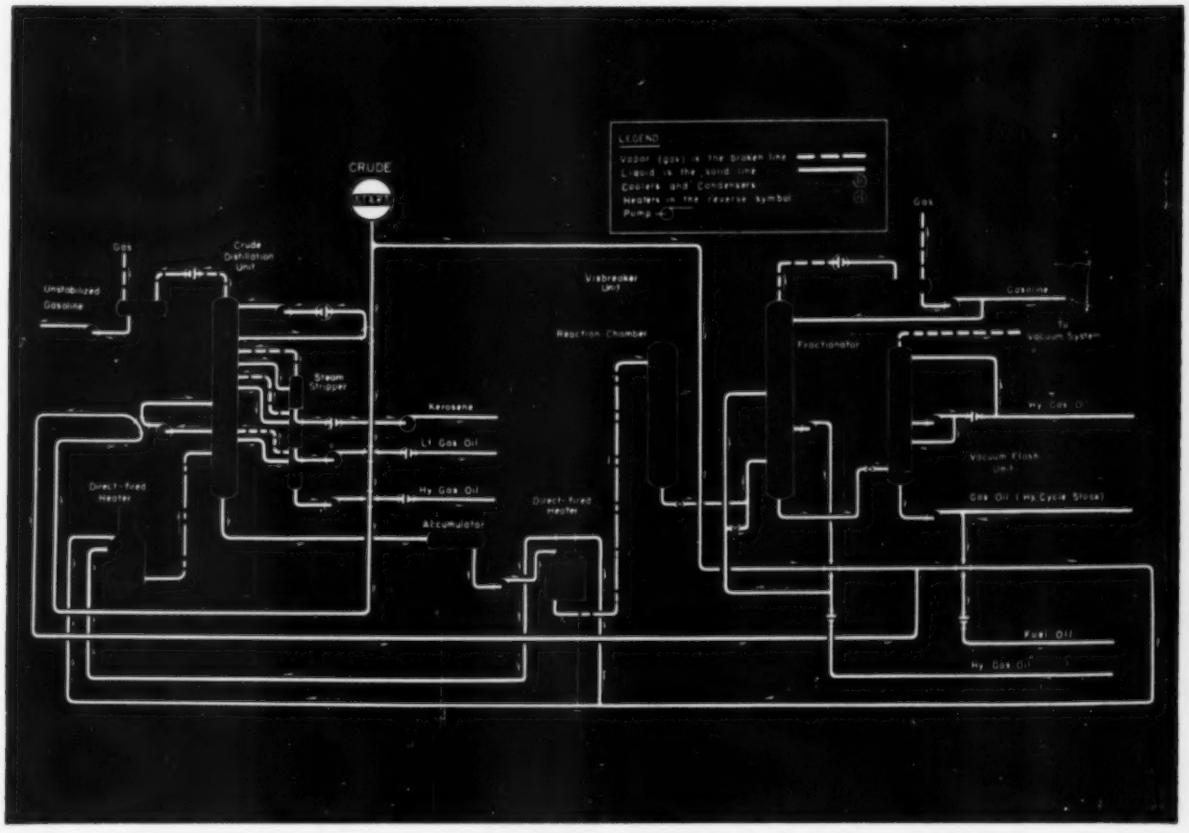
The flow sheet given shows one type of combination cracking. The design of such a unit varies with the specific needs of the refiner. However, each unit is basically designed for the segregation of cracking stocks and their independent selective cracking under optimum conditions. The segregation of cracking stocks is based according to both refractivity and boiling range. The selected stocks are cracked under closely controlled conditions in heaters of special design to obtain maximum conversion per pass larger yields and longer runs.

Modern development and improvement in catalytic cracking greatly reduced the application of thermal cracking processes in the refining of petroleum in the United States. However, it still remains an excellent balance tool in processing catalytic cycle stock and an excess of heavy oils into additional production of gasoline. In countries where there is no race for high octane number gasolines, the thermal cracking processes are still in demand, particularly for combination units with topping, vis-breaking and gas oil cracking.

To illustrate the versatility of units of this nature, during the initial run of a four coil unit it was possible to switch from one crude oil to another of a different type, without interrupting the run or making any off specification products.

Commercial Installations—Twelve.





Combination Visbreaking—FOSTER WHEELER CORPORATION

Application—Combination Visbreaking combines the operations of crude distillation, visbreaking, and vacuum flashing. The visbreaking process reduces the viscosity and pour point of the ultimate fuel oil product and provides additional feed stock for catalytic cracking.

Charge—Crude oil to the distillation unit, reduced crude to the visbreaking unit, and visbreaker heavy residual bottoms to the vacuum flash unit.

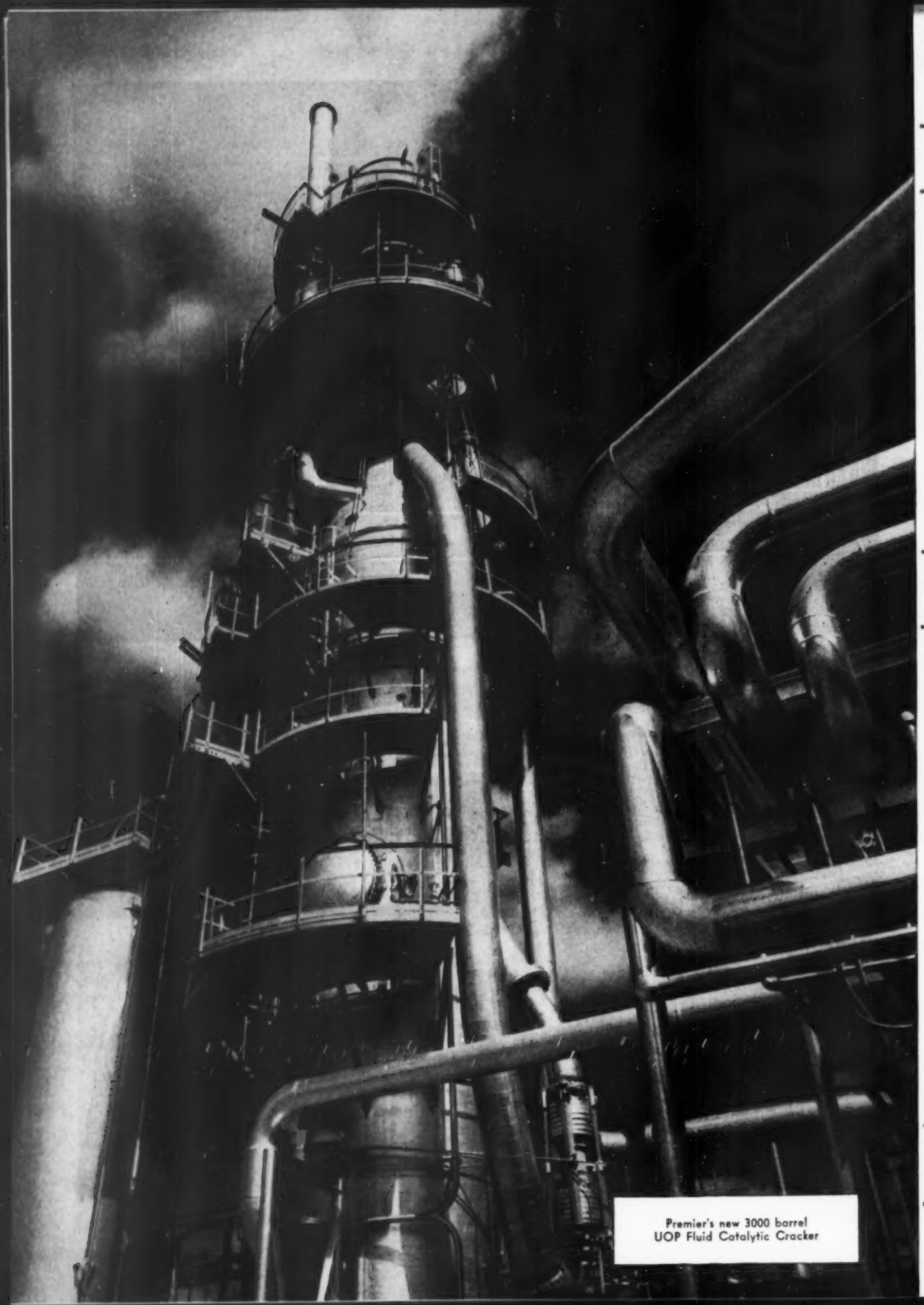
Products—From the crude unit, unstabilized gasoline, kerosine, light gas oil, heavy gas oil and reduced crude. From the visbreaking unit, gasoline, heavy gas oil, cracking stock, and a heavy residual as bottoms. From the vacuum flash unit, heavy gas oil and fuel oil.

Description—Referring to the flow diagram, the crude entering the combination unit is split into two streams. The first stream exchanges heat with the top-of-column pumparound of the crude distillation column. It then picks up additional heat by heat exchange with the light and heavy gas oil side streams from the crude distillation column. Further heat is added by heat exchange with the mid-pumparound of the crude distillation column. This crude stream then joins the other crude stream which has been preheated by exchange with the pumparound system of the visbreaker fractionator. The combined streams pick up more heat by heat exchange with the bottoms from the vacuum flash unit annd then flow directly to the direct-fired heater of the crude distillation unit. Part of this combined stream passes through the convection section of the direct-fired heater of the visbreaker unit and then flows to a lower pressure position in the direct-fired heater coil. The preheat temperature of the combined stream leaving the last heat exchanger is 495 F., while the temperature of the stream further preheated in the convection section is 640 F.

In the direct-fired heater of the crude distillation unit the crude is heated to a temperature of 725 F. and the liquid-vapor stream enters crude distillation column where it is separated into unstabilized gasoline as a top-of-column product, kerosine, light gas oil and heavy gas oil as side streams and reduced crude as the bottoms.

The reduced crude flows to an accumulator from which it is pumped into the direct-fired heater of the visbreaker unit. In this unit, under a pressure of 250 pounds, it is raised in temperature to 920 F., and then enters a reaction chamber where the cracking and visbreaking is completed. Leaving the bottom of this reaction chamber the combined liquid-vapor stream enters the visbreaker fractionator where it is separated into visbreaker gasoline, heavy gas oil, cracking stock, and a heavy residual as bottoms. These bottoms then flow to the vacuum flash tower where, under an absolute pressure of 20 mm. Hg there is produced additional quantity of heavy gas oil to be used as feed stock for the fluid catalytic cracking unit. The bottoms from this vacuum flash tower are blended to fuel oil specifications with, for example, a heavy cycle stock, and pass through a cooler to storage.

This unit is now in operation at the Barrancabermeja, Colombia, refinery of Empresa Colombiana de Petroleos. The crude distillation unit has a capacity of 30,000 barrels per day, and the visbreaker 16,500 barrels per day.



Premier's new 3000 barrel
UOP Fluid Catalytic Cracker

New Cat Cracker Placed in Operation By Premier

By R. P. Hargis, President
Premier Oil Refining Company of Texas
Longview, Texas

PREMIER Oil Refining Company of Texas recently completed a multi-million dollar expansion program at Fort Worth, Texas, making our refinery there one of the most modern in the entire Southwestern area.

R. P. Hargis

The expansion program was rounded out April 10 when a 3,000 B/SD UOP Fluid Catalytic Cracking unit of the latest design went on stream. It is designed to crack blended atmospheric and vacuum gas oils at a conversion rate of 74 per cent into gasoline having 92 clear research octane rating.

Installation of the cat cracker, with its attendant new polymerization and gas concentration facilities—all three of which were designed and licensed by Universal Oil Products Company—brings to six the number of major processing units in operation at the Fort Worth refinery. Others are a UOP Platforming unit, which has a design capacity of 1,500 B/SD, a thermal cracker, and a crude unit. With these facilities, the Fort Worth refinery has now become self-sustaining. Its supply of crude oil is piped from the Ranger Field into Fort Worth.

Four Reasons for New Unit

Four major factors motivated our thinking about installing a cat cracker less than three years after the company built the UOP Platforming unit. These factors were, in brief:

1. A cat cracker would enable Premier to make greater amounts of high quality finished gasolines; it would open up new avenues for marketing such products as butane-butylene; it would put Premier in the position of converting excess middle distillates into marketable products.

2. It would provide not only the Fort Worth refinery but Premier's other Texas refineries at Arp, Baird and Longview with a choice gasoline blending stock having an F-1 leaded octane number of 98 to 100.

3. It would further improve the refinery's economic position by making possible a larger gasoline yield from the crude run. The overall gasoline yield at the Fort Worth refinery was 52 per cent. It was estimated that with a cat cracker a gasoline yield of 67 per cent could be obtained—an estimate that since has proved to be accurate.

4. A cat cracker would permit operating the refinery at its crude oil capacity of 7,500 B/CD.

Coincident with the unit going on stream, Premier launched an intensive newspaper, radio and TV advertising campaign to introduce its new "Ignition Controlled" ethyl gasoline and "Dynamic" regular gasoline. We are now producing a 95 octane premium gasoline and an 86 regular motor fuel to meet the ever-increasing demands for higher quality gasolines in our trade territory.

We supply approximately 100 independent jobbers and more than 600 retail outlets in an area extending from Shreveport, La., on the east to Abilene, Texas, on the west, and from the Red River on the north to the central portion of Texas on the south.

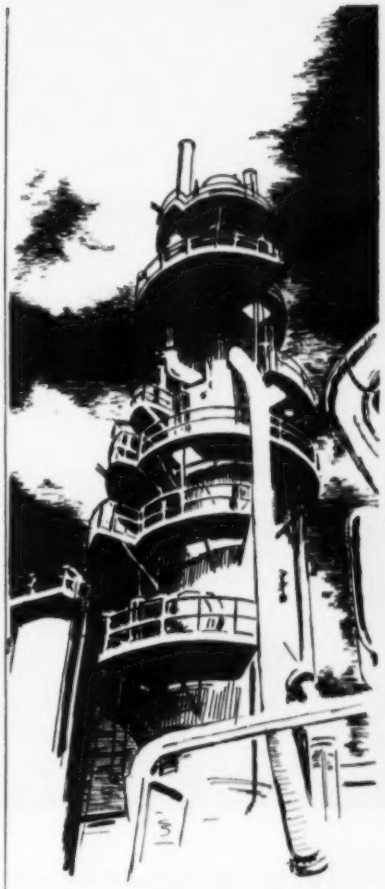
Octane Ratings Increased

Gasoline from the cat cracker is being transported to the Arp, Baird and Longview refineries for use as blending stock. This enables these plants to increase their octane ratings, and puts them in a more advantageous position to meet changing market conditions.

One of the unusual features of our new cat cracker is the placement of the reactor-regenerator on a structural steel skirt instead of having it mounted on a concrete base. Another interesting feature is the suspension of the air heater beneath the regenerator.

All of the pumps and the gas compressors are located under a reinforced concrete structure extending across the battery area parallel to the line of towers. Most of the heat exchangers, surge drums and receivers are placed on the roof of the concrete structure. This arrangement makes for compactness and maximum utilization of space, and enables our operators to control the unit with ease.

With the cat cracker now on stream, we are confident that the Fort Worth refinery is equipped to meet a wide variety of marketing conditions more profitably and with a greater degree of flexibility than was ever possible before.



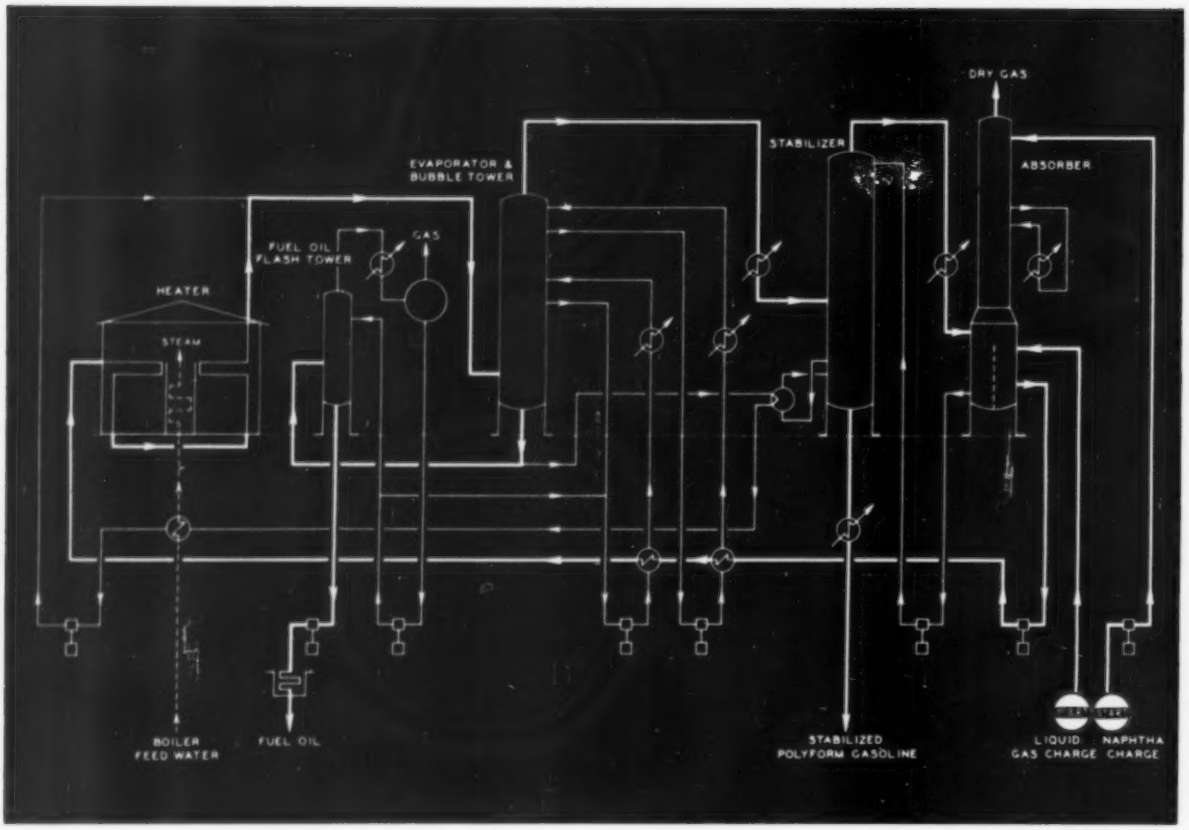
PREMIER INCREASES GASOLINE YIELD WITH UOP FLUID CATALYTIC CRACKING UNIT

designed, engineered and licensed by

UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD,
DES PLAINES, ILL., U. S. A.
Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Investment



Polyforming—GULF OIL CORPORATION

Application—This process affords a means for converting straight run naphtha, gas oils and extraneous light hydrocarbons into high quality motor gasoline.

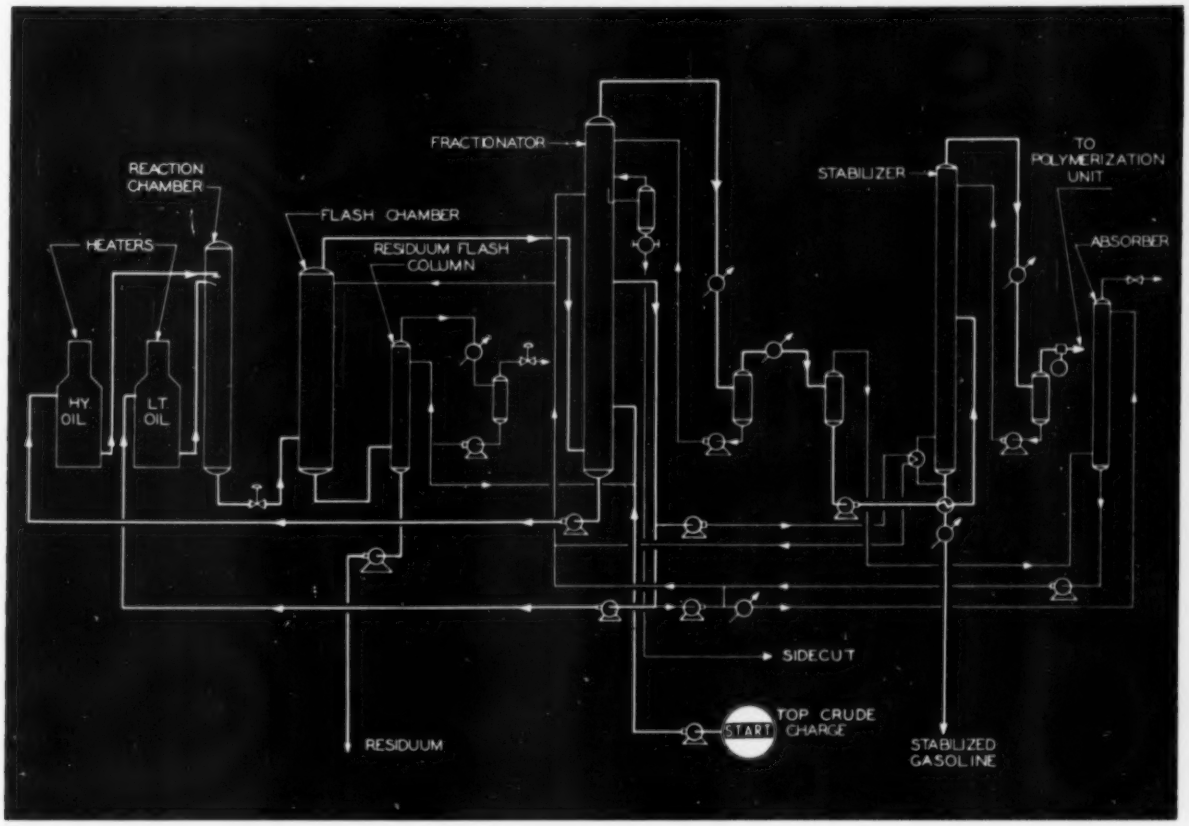
Charge—Designed to process naphtha, gas oils and condensable light hydrocarbons simultaneously, the process has found most extensive application in charging low-octane naphthas, although there are in operation a number of units charging gas oil.

Products—High quality motor gasoline and fuel oil.

Description—Polyforming units charging a wide variety of heavy naphthas with and without condensables achieve higher yields of high-octane gasoline than is possible with conventional reforming units operating in conjunction with catalytic polymerization facilities. The flow diagram illustrates the process arrangement of a typical naphtha polyforming unit. The naphtha is charged to the absorber which is so operated that about 80 to 90 percent of the propane in the wet gas entering the tower is absorbed. At the base of the absorber the rich oil combines with the stabilizer overhead condensate to make up the furnace feed which is charged with a high pressure centrifugal pump so that the resultant transfer-line pressure is 1200 to 1500 psi. Evaporator bottoms are employed to reboil the stabilizer and quench the transfer-line to 650 to 700 F. The evaporator bubble tower operates at about 400 psi pressure. The net evaporator bottom flows to a fuel oil flash tower, the overhead of which is returned to the system and the bottoms are delivered to fuel oil. The bubble tower is controlled with intermediate and top circulating reflux systems which preheat the furnace feed while the overhead flows through a partial condenser directly to the stabilizer, operating at about 330 psig. The stabilizer may operate as a depropanizer if it is desired to produce butane-butylene for alkylation or may operate to produce specification vapor pressure gasoline with excess butane-butylene being taken overhead for conversion to gasoline. A large part of the propane-propylene and butane-butylene in the stabilizer overhead is condensed and flows to the base of the absorber, while the uncondensed wet gas flows through the absorber where it is stripped of propane and is then discharged as refinery fuel gas.

By this scheme propane-propylene and butane-butylene produced in the process are largely condensed with normal cooling water supply and the balance is absorbed in the naphtha feed. Extraneous light hydrocarbons may be charged into the furnace-feed accumulator as a liquid or charged to the main high-pressure absorber. Condensed liquid gas is circulated with the feed and the presence of this material in the furnace charge enables substantially more severe temperature and pressure conditions than could otherwise be achieved. This, in addition to the polymerization of the light hydrocarbons, results in the high gasoline yield and octane associated with the process.

Yields—Ten-pound-RVP gasoline ranging from 50 to 70 percent has been obtained from virgin gas oils while yields of 40 to 60 percent will be derived from catalytic cycle stocks (ASTM octane of 72 to 76 for virgin stocks and somewhat higher for cycle oils).



Thermal Cracking—UNIVERSAL OIL PRODUCTS COMPANY

Application—The process produces gasoline from every variety of charging stock, from naphthas to the heaviest crudes and residual oils.

Thermal cracking produces butylenes and propylene which can be polymerized to produce polymer gasoline of high octane number for use as a blending fluid to improve the quality of other gasolines.

Description—The ideal equipment for thermally cracking topped or reduced crudes is centered about the two-coil cracking unit designed for optimum results when producing high-grade cracked fuel oil residuum.

The topped or reduced crude charge is introduced to the side of the fractionating column where it is contacted with the vapors from the flash chamber. The overhead product from the fractionating column is end point gasoline. Furnace or tractor distillates are withdrawn as sidecuts and stripped to specifications. From a lower sidecut tray a higher boiling distillate comprising the lower boiling fractions of both the recycle and charging stocks is withdrawn as charge to the light oil heater. The charge to the heavy oil heater is withdrawn from the bottom of the fractionating column, and consists of the highest boiling fractions of both the recycle and charging stocks.

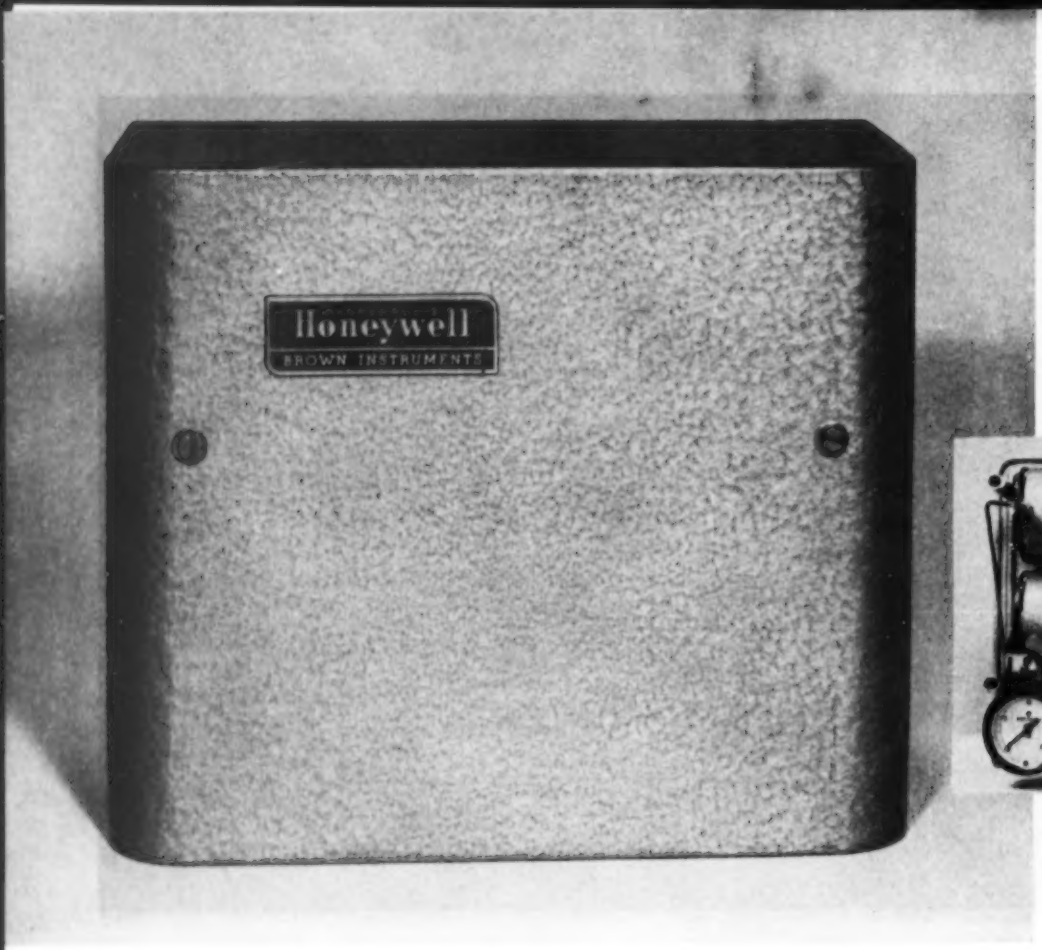
The transfer lines from the two heaters enter the top of a downflow reaction chamber. This chamber is operated without a liquid level, since all of the products are withdrawn from the bottom through a pressure control valve.

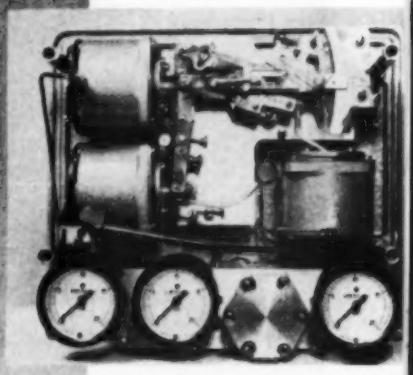
The mixture leaving the reaction chamber enters the flash chamber in which a fuel oil residuum of the desired properties is separated.

Yields—To illustrate the comparative results obtained in various methods of processing, the following yields are presented as representative results when charging a typical 25° API Mid-Continent reduced crude having a viscosity of 20 SFS at 122 F. In considering these results, it must be remembered that not only the gravity but also the viscosity of the charge is important in determining yields.

	Maximum Gasoline	Maximum Furnace Oil
Percent by Volume of Charge:		
Gasoline, 400 E.P., 10 RVP	53.5	38
Furnace Distillate		23
Fuel Oil	37.5	34
Liquid Volume Loss	9	5
Gas, Cu. Ft./Barrel	500	290
Octane Number (ASTM)	69-70	68-69
Fuel Oil, Viscosity, SFS at 122 F	200	200
Fuel Oil, Gravity, °API	7	8
Percent Catalytic Polymer Gasoline, 10 RVP	5	3.5
Percent Total Gasoline, including Polymer	58.5	41.5
Octane Number of Total Gasoline	71-72	70-71

It should be noted that the cracked gasoline yields are all reported on the basis of 400 F. end point and 10 RVP. On the basis of total butane-butylene retention in the gasoline the yields would be increased approximately 4 percent respectively. The yields of catalytic polymer gasoline shown in the table are on the basis of polymerizing 80 percent of the propylene and butylenes formed in the cracking operation.





Interior view of Ratio Relay shows simple, compact construction. Pressure gages indicate input signals and output pressure. Adjustments for control action, zero setting and ratio range are readily accessible.

The Tel-O-Set Ratio Relay offers these unique features:

★ **LINEAR RATIO**

Output changes in straight-line relation with primary variable. Permits better control tuning . . . eliminates "compromise" settings.

★ **DIRECT OR REVERSE ACTION**

Readily set to provide either increasing or decreasing output . . . increasing or decreasing ratio.

★ **FLEXIBLE ADJUSTMENT**

Ratio range can be reduced to any desired value. Reduced span can be positioned at any desired portion of the maximum range. Factory setting is 50—150% ratio range.

★ **WIDE RANGE**

Ratio can vary from 0 to 200% for a full scale change in the primary variable.

★ **ADJUSTABLE LIMITS**

Readily set stops are provided to limit minimum and maximum output pressure.

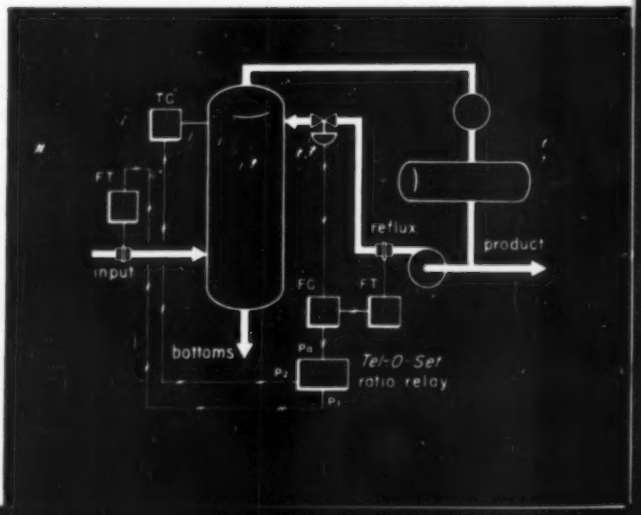
★ **ZERO SUPPRESSION**

Independent zero adjustments permit selection of the exact input-output relationship desired.

★ **INDICATING GAGES**

Separate indicators show output pressure and both input pressures.

On a distillation column, Tel-O-Set Ratio Relay receives air signal (P_2) from column temperature controller. This signal varies the ratio of the output pressure (P_0) to the signal received (P_1) from the input flow transmitter. Output pressure feeds into an *Indexet* remote setting index in the flow controller, to reset this instrument and thus throttle the valve in the reflux line. Ratio of reflux to input is thus varied in accordance with temperature of the top of the column.



New, versatile means for effecting cascade control

the Tel-O-Set Ratio Relay

HAVE a complex control loop? Here's a versatile way to simplify it . . . the new *Tel-O-Set* Ratio Relay. Another advanced idea in process control from Honeywell, this unique relay proves the ideal solution to complex cascade control problems.

The Ratio Relay provides automatic control with a single element influenced by three interrelated variables. For example, it is used on distillation columns (see diagram) to control the ratio of reflux to feed, as column temperature varies. In absorption towers, it regulates ratio of absorbent and feed stock to give constant concentration of product. And there are scores of other uses for this relay . . . in evaporators, controlled-atmosphere furnaces, reaction tanks, engine testing and other applications where several related variables must be interlocked for efficient operation.

The Ratio Relay receives pneumatic signals from remote transmitters, controllers or manual loading stations. It produces an output air signal for readjusting the set point of a secondary controller. It is the ideal companion for Honeywell Differential Converters, *Tel-O-Set* miniature instruments and Brown pneumatic controllers.

Your nearby Honeywell sales engineer will be glad to discuss applications to your specific process . . . and he's as near as your phone.

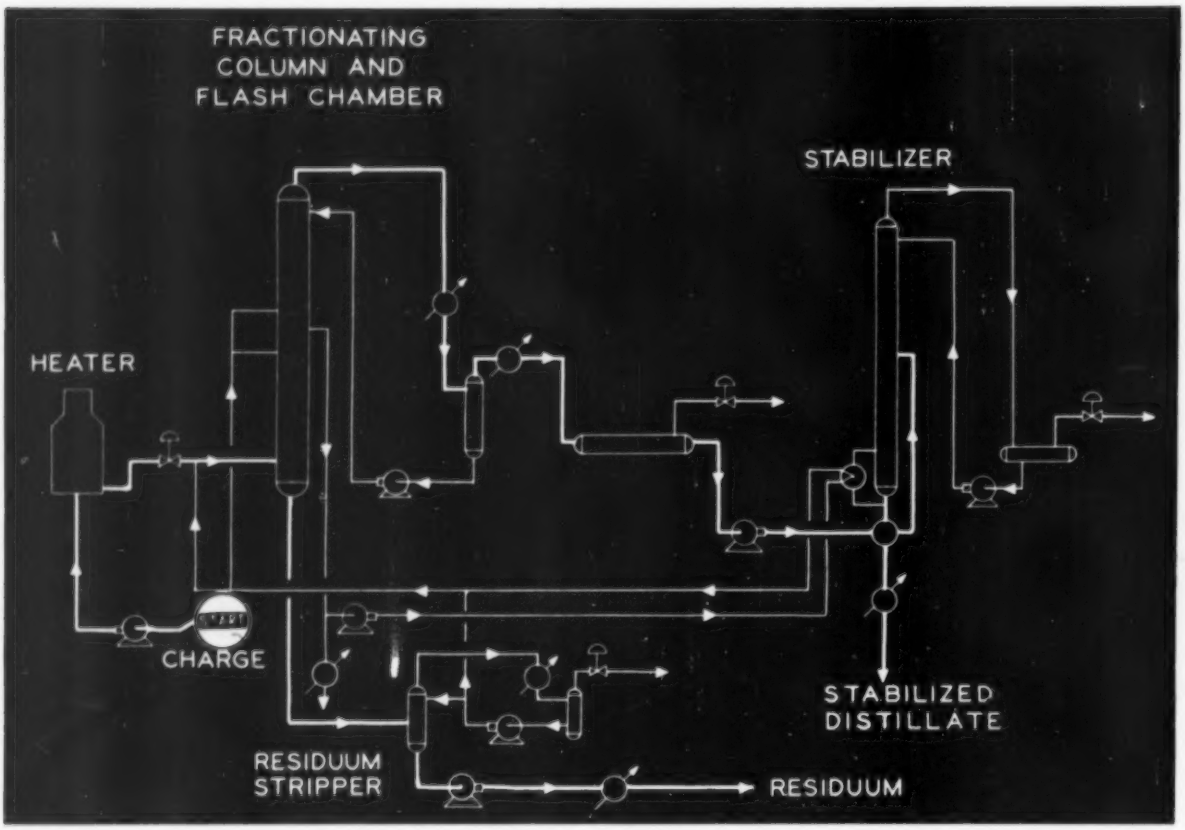
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Bulletin 8410, "*Tel-O-Set* Ratio Relay."**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls



Thermal Reforming—UNIVERSAL OIL PRODUCTS COMPANY

Application—The process converts low-grade gasolines and naphthas into high-octane gasoline.

Thermal reforming produces butane-butylenes and propane-propylene which can be polymerized to produce a high-octane polymer gasoline which is an excellent blending material for improving the quality of other gasolines. The residuum produced by this operation has a high calorific value, and can be marketed as fuel oil.

Description—A straight-run gasoline or naphtha fraction is charged to a heater wherein the reaction time, pressure, and discharge temperature are controlled to produce the desired products. The effluent from the heater passes through a pressure control valve where the pressure is reduced. A quench stream from the fractionator is introduced after the control valve to reduce the temperature of the effluent and minimize coking.

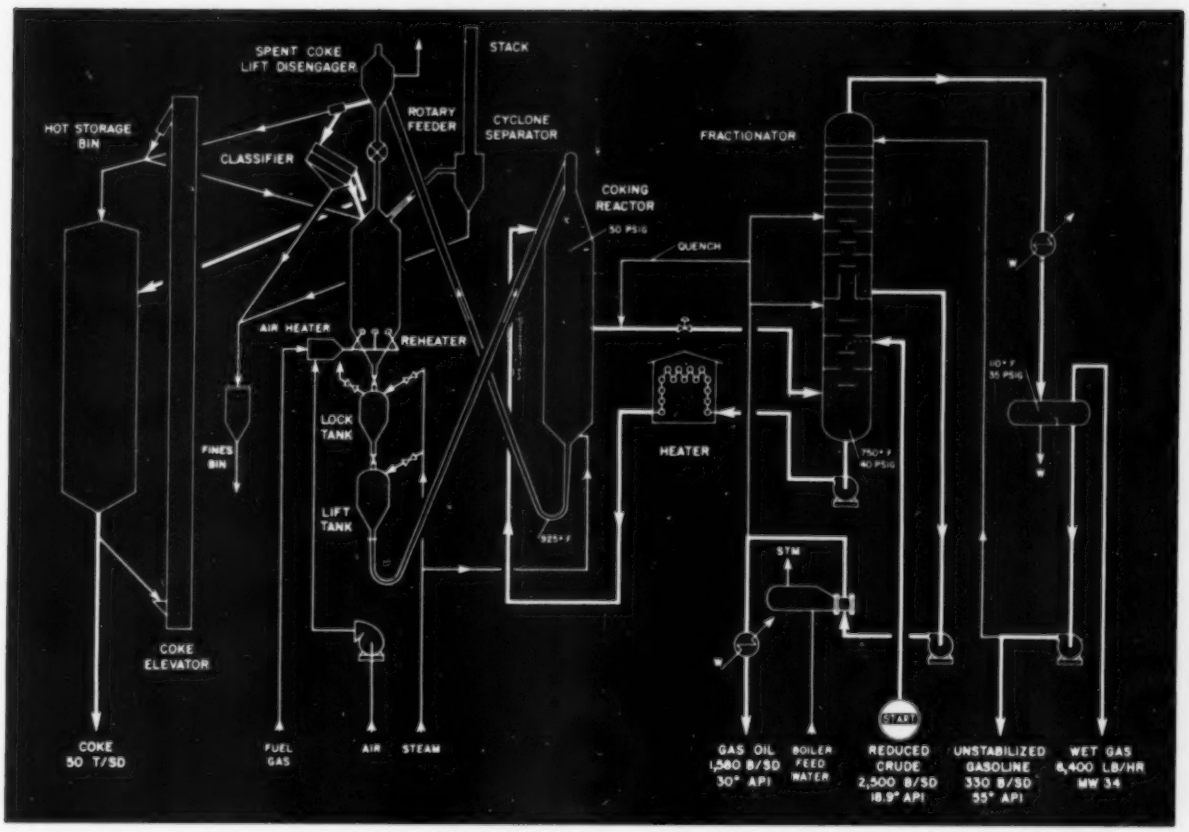
The quenched products enter a combination flash chamber and fractionating column wherein the gas and gasoline are taken overhead, and the small amount of bottoms produced is removed from the lower portion of the vessel. A cracked naphtha side-cut from this column is used for quench and heat exchange duty. Naphtha side-cuts may be withdrawn if desired.

The overhead products from the fractionator are cooled, and the condensed, unstabilized gasoline is sent to a stabilizer to produce the desired vapor pressure. If polymerization of the gases evolved from the cracking operation is desired, an absorber for the receiver gases plus deep stabilization of the gasoline is employed to provide maximum recovery and utilization of polymerizable olefins available.

The bottoms withdrawn from the flash chamber portion of the reformer column are further flashed in a residuum stripper. Light overhead material removed from the residuum at this point is condensed and returned to the fractionating column, whereas the residuum is sent to storage for subsequent disposal as fuel oil. The properties of the residuum are regulated by suitable control of the reflux to the stripper.

Yields—A typical result when reforming a 53° API Mid-Continent straight-run naphtha is shown below.

Charging Stock:	
Gravity, °API	53.0
Octane Rating, ASTM (F-2) Clear	40.5
Characterization Factor	11.96
100 ML Distillation:	
IBP, F	208
10 Percent	263
50 Percent	314
90 Percent	367
E.P., F	389
Products:	
Gasoline:	
Yield, Volume Percent of Charge	81.3
Gravity, °API	56.1
Reid Vapor Pressure, Lb.	10.0
100 ML Distillation:	
IBP, F	93
10 Percent	145
50 Percent	270
90 Percent	360
E.P., F	398
Octane Ratings:	
ASTM (F-2), Clear	70.2
+ 3 cc. TEL/Gallon	81.9
Research (F-1), Clear	78.2
+ 3 cc. TEL/Gallon	91.3
Residuum:	
Yield, Volume Percent of Charge	4.2
Gravity, °API	18.2
Gas:	
Yield, Weight Percent of Charge	15.3
Cu. Ft./Barrel of Charge	467



Continuous Contact Coking—THE LUMMUS COMPANY

Application—This process is employed to increase gasoline yields from reduced crude, shale oil, asphalts, and naturally occurring bitumens by conversion to catalytic cracking feed stock.

Charge—Reduced crude, shale oil, and naturally occurring bitumens.

Products—Gas, gasoline, gas oil and coke.

Description—The Continuous Contact Coking process permits degrees of freedom in the areas of time, temperature and pressure which are impossible in delayed coking. The contact coking process places no limitation on the volatility of the charge stock and can process any heavy tar or pitch that can be pumped to the unit.

In the operation of the unit, heated reduced crude is charged to the bottom section of the fractionator where material boiling in the desired product gas-oil range is removed.

A stream of hot coke pellets is continuously circulated through the reactor vessel and the reheater. This circulation is obtained by means of mass lift with high pressure steam providing the motivating force. The bottoms from the fractionator is contacted with the reheated circulating coke at the inlet of the coking reactor.

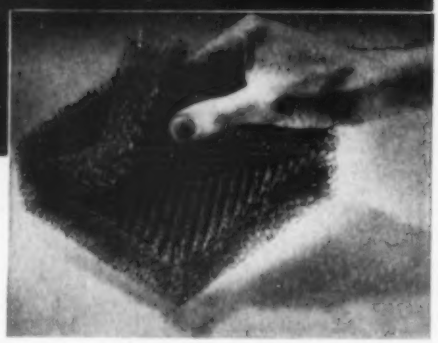
In the oil-coke contacting zone the lighter portions of the reactor charge are vaporized and the heavier unvaporized material is deposited as a liquid film on the coke particles. The wetted coke particles flow by gravity through the reactor as a compact bed. In the reactor sufficient residence time is allowed to permit the coking and drying reactions to go to completion. At an intermediate point in the reactor, product vapors are removed through an internal drawoff device and the coke passes down below this vapor disengaging zone into a stripping zone where final drying is accomplished. From the bottom of the reactor, the dried coke particles are elevated by mass lift to the lift disengager from which they flow by gravity through a flow regulator into the coke reheater. A small slip stream flows through a classifier to remove the net production of coke and to control particle size in the reheater. The reheated coke is discharged by gravity into the lock tank, which forwards it into the high pressure lift tank for recirculation back to the oil-coke contacting zone in the top of the reactor. As oil is charged to the anit, successive increments of coke are deposited upon the circulating coke, resulting in a gradual increase in particle size and in the coke inventory. The inventory is kept in balance by the classifier.

Product vapors from the coking reactor pass to the bottom of the fractionator. This tower carries out the desired product separation and also produces bottoms suitable for charge to the reactor.

IS LIQUID CARRY OVER–

. . . Limiting Your Production?
. . . Affecting Product Purity?
. . . Cutting Into Your Profits?

IF SO–GET THE FACTS ON METEX MIST ELIMINATORS!



Section of a METEX MIST ELIMINATOR, opened to show construction. They can be made of practically any metal, to combat corrosion. Factory cut to fit vessel dimensions and contour, there is no limit to the size in which they can be obtained.

Liquid entrainment need no longer be considered an unavoidable nuisance in processing operations, as more and more engineers are finding from experience. These *knitted* wire mesh entrainment separators literally "filter out" the entrainment (see diagram) and permit the gas to pass on, freed from the unwanted–and often contaminating–liquid.

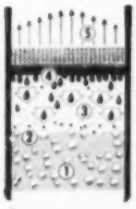
METEX MIST ELIMINATORS can be easily installed in new or existing vessels. They require no special housings, equipment or power–and need no servicing or attention. They function over a wide range of velocities with a pressure drop usually so low it cannot be measured. Users report efficiencies of 99% and more.

METEX Mist Eliminators can be used wherever the problem of liquid entrainment exists. By effecting complete removal of liquids, Mist Eliminators contribute to more efficient and economical processing in such vessels as:

- VACUUM PIPE STILLS
- FRACTIONATING TOWERS
- KNOCK-OUT DRUMS
- EVAPORATORS
- ABSORBERS
- SCRUBBERS
- COMPRESSORS
- SEPARATORS
- STEAM DRUMS

Write TODAY for free catalog giving complete information and engineering data. Or tell us about your SPECIFIC entrainment problem.

When a gas is generated in or passes through a liquid (1), it carries with it on leaving the surface (2), droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3). As the gas continually changes direction in passing through the pad, the droplets are impinged on the extensive wire surface. Here the droplets coalesce, forming large drops of liquid which break away (4) from the pad and fall back through the gas stream. The gas (5) passes on, freed from liquid entrainment.



METAL TEXTILE CORPORATION

KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

METEX

Roselle, New Jersey

CATALYST CONTAMINATION CURED BY REMOVING ENTRAINMENT IN DISTILLATION UNIT

Equipment Costing $15,000 Pays Out In Under A Week For Large Southwestern Refinery

It was not a difficult problem to trace the cause of mounting catalyst losses to a cat unit feed so poor in color that it was essentially black. Entrainment of liquid from the bottom of the still column could be the only answer.

Here was a situation where a Metex Mist Eliminator would remove the entrainment – but what else might happen? Would this knitted wire mesh separator cause excessive pressure drop? How quickly would it become plugged by coke deposits and make the column inoperable?

Calculations by one engineer showed that the total cost of installing a 25-ft diameter Mist Eliminator, including designing and erecting supports within the still, was approximately $15.000 – less than a week's catalyst loss. After considerable study the decision was made, and the Mist Eliminator installed during the next routine turnaround.

When the first run of cat unit feed came from the remodeled crude distillation unit, it was crystal clear and water white. Throughout the normal run no differential pressure across the screen was found.

The problem was solved. Catalyst losses dropped sharply. And the Mist Eliminator has paid for itself in a matter of days.

Have you really analyzed your entrainment costs, and checked the savings a Mist Eliminator could make for you? Perhaps you are losing valuable end products in the exhaust stream. Perhaps you have a nuisance contamination problem. Perhaps the entrainment created in one vessel is causing trouble in a subsequent operation. For entrainment is an inevitable result of most processing and refining operations.

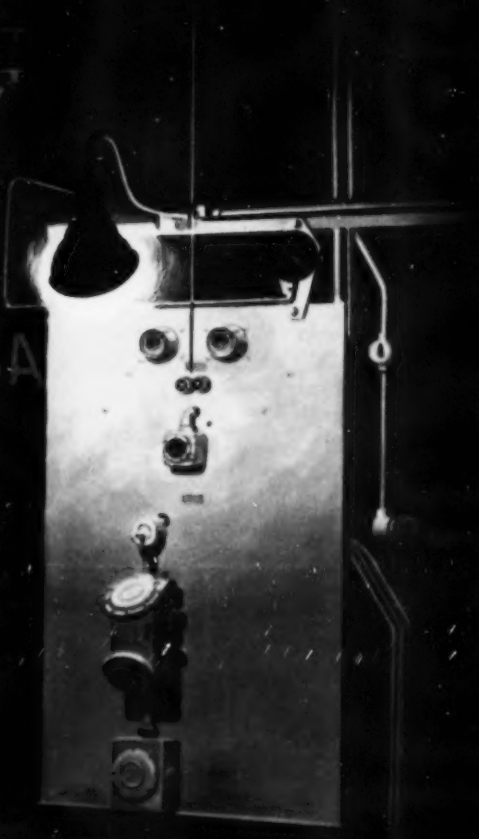
Metex Mist Eliminators perform just one function–and they are doing it in more and more refining vessels every day. They remove liquid entrainment–efficiently and economically–wherever it may occur.

Why not write today for more information on Metex Mist Eliminators. Or better yet, send data on your particular entrainment problem. We'll be glad to have our engineers check this, and send you our recommendations and suggestions. (Adv.)

wide awake employee

These are pilot lights on a Howe-Baker desalting unit installed in a major refinery. They haven't blinked for more than a year. As long as they continue to shine the operator can be sure the unit is operating at full efficiency and the plant is on an uninterrupted ON-STREAM schedule.

The prime objective of Howe-Baker design is a long continuous period of uninterrupted operation. That's why refiners throughout the world consult Howe-Baker on their emulsion problems. On 3 continents more than 1,000,000 barrels of crude oil per day are being treated by Howe-Baker custom designed electrostatic units. Call us for a discussion of your requirements.



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ESPERSON BUILDING HOUSTON, TEXAS

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a complete package! *DESIGN, ENGINEERING, CONSTRUCTION*

MACCO is recognized and qualified by the patent holders for engineering and erection of many patented processes such as platforming, catalytic cracking, catforming, furfural extraction, Duo-Sol, alkylation, etc. Our engineering department comprises an established and well integrated group of process and design engineering specialists. For a complete unit or plant packaged service, delivered on a turn-key basis with a minimum investment... consult MACCO.

MACCO CORPORATION

MACCO *REFINERY DIVISION*

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R-3

Selectivity

The polar molecule is highly selective in its solvent action permitting ready extraction of the "undesirable" constituents of petroleum oil.

Productivity

The furfural operation produces high yields of quality oil.

Availability

Production from a variety of agricultural residues makes ample quantities available the year 'round.

Stability

Furfural is thermally stable under conditions of use.

Recovery

Furfural is readily recovered. The experience of over 40 plants using furfural proves that solvent losses are low.

Versatility

The large variety of furfural-processed petroleum products range from lube oils to catalytic cracker recycle stock. A related technique, extractive distillation, is applicable to other petroleum products such as the separation of C_4 hydrocarbons.

Separability

High density together with low surface tension permit rapid phase separation.

Handling

The low freezing point of -34°F. assures trouble-free handling throughout the year—unclogged lines in winter.

Health Factor

Years of use in the petroleum industry show that furfural may be handled safely without injury to those working with it.

For a further check into the physical side of QO Furfural, write for Bulletin 203.

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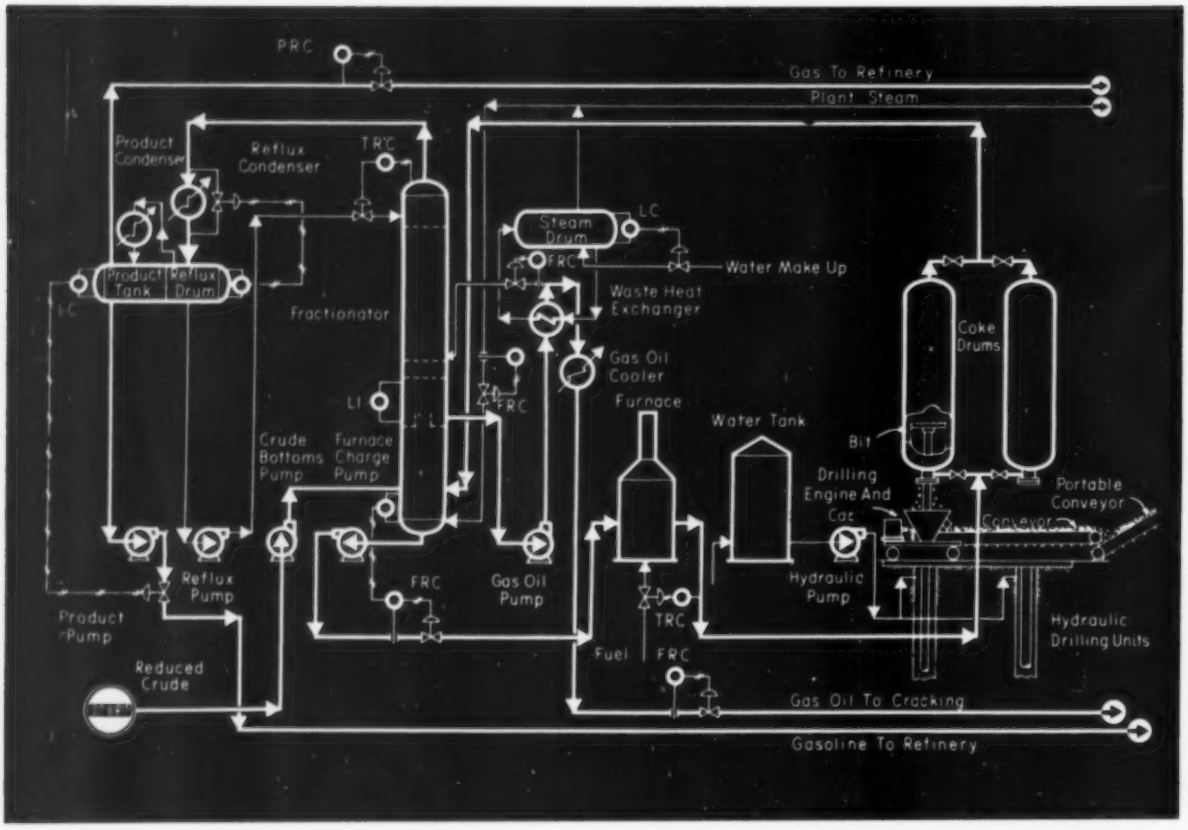


Decarbonizing—BLAW-KNOX COMPANY

Application—Decarbonizing is designed to process a reduced crude and produce a maximum yield of coker distillate for catalytic cracking, minimum coke and coker gasoline.

Charge—Any reduced crude from topped crude to vacuum tower bottoms.

Product—Products consist of clean (low Conradson carbon) catalytic cracking feed stock, a controllable yield of high-grade petroleum coke, useful as a raw material in certain chemical process industries and coker gasoline.

Description—The hot reduced crude charged to the decarbonizing unit is pumped into the base of the fractionator. A portion of the fresh feed is flashed in the base of the fractionator by the addition of stripping steam and the heat supplied by the coke drum effluent. This insures maximum vaporization of the fresh feed and minimum charge to the coke drums.

The fractionator bottoms stream is pumped through a furnace. From the furnace the charge flows to one of the coke drums. Vapor and liquid enters the bottom of the coke drum and vapor leaves the top. The liquid remains in the coke drum and is converted to coke, under the time-temperature conditions which prevail there. In the usual two-drum installation, one coke drum is in coking operation while the other is being decoked.

The vapors from the coke drum flow to the base of the fractionator. The gas oil is condensed and withdrawn from a well-type tray. Gas-oil product plus intermediate reflux is pumped through a waste-heat-exchanger generating process and utility steam. Stripping steam, gas and gasoline are taken overhead and cooled to condense the gasoline product plus the necessary reflux. The coke drum and fractionator are operated at pressures consistent with the desired product distribution between coke and distillate.

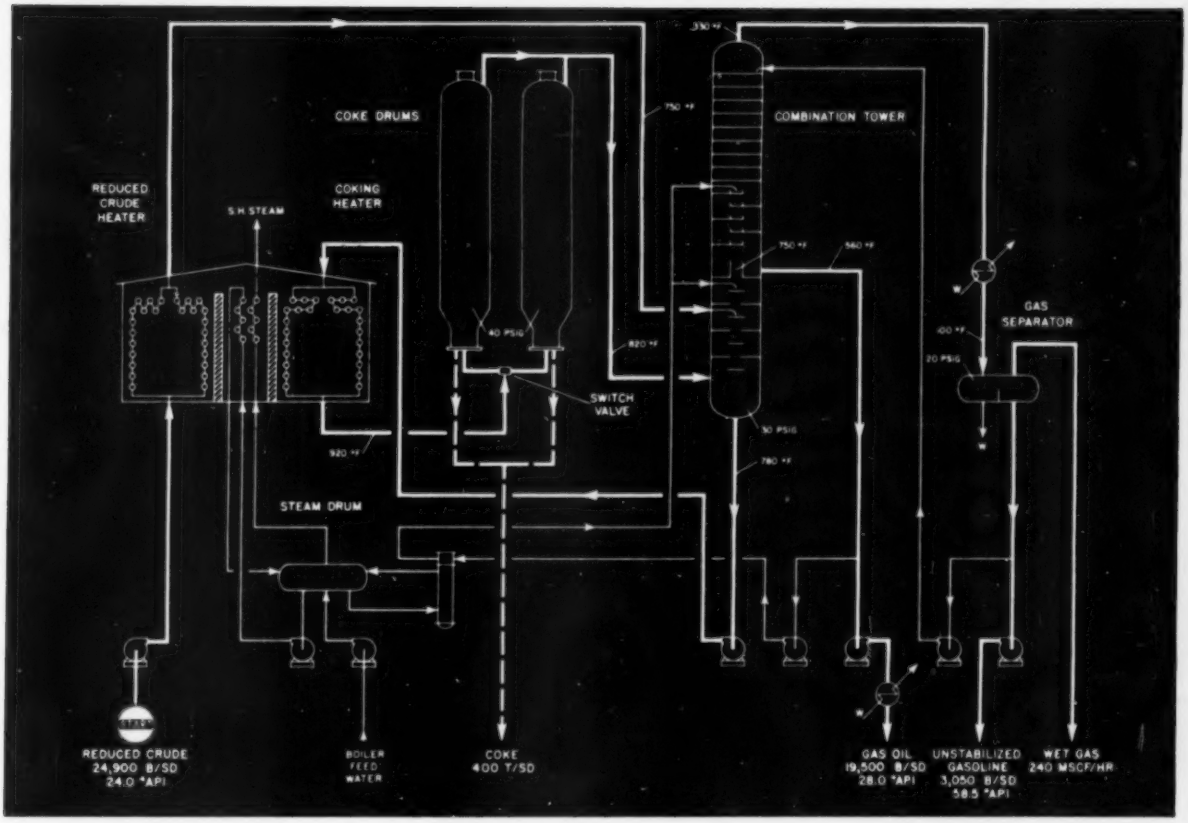
In the usual operating cycle, the full coke drum taken off stream is steam purged. After steam purging, the coke is cooled with water. Water is added to the bottom of the drum and the steam formed is vented to the blow-down stack. After cooling, the water is drained. The decoking crew unheads the coke drum and positions the drilling engine. Coke drilled out falls out the bottom of the coke drum and is funneled on to a conveyor belt which carries the coke to a pile or directly to railroad cars.

Operating Conditions—The major process variables are pressure and temperature. This is a low temperature-low pressure operation compared to conventional delayed coking units. Normal operating pressures range from 10 to 25 psig. Heater outlet temperatures are in the range of 900 to 910 F. with the top temperature of the coke drums from 775 to 785 F.

Yields—Typical yields for light and heavy residuum:

CHARGE	East Texas	Mid-Continent
Reduced Crude, Barrels, per Day	10,000	10,000
Reduced-Crude—Inspections:		
Gravity, °A.P.I.	26.0	14.4
Carbon Residue	3.98	12.2
Yields:		
Gas Mscfd	1,000	2,750
Gasoline, Barrels, per Day	675	1,300
Gas Oil, Barrels, per Day	9,000	7,040
Coke, Tons, per Day	87	280

Commercial Installations—the first decarbonizing unit was installed for McMurrey Refining Company, Tyler, Texas, in May 1954.



Delayed Coking—THE LUMMUS COMPANY

Application—The process is employed to convert reduced crudes normally suitable only for fuel oil to catalytic cracking feed stock to increase refinery gasoline yields.

Charge—Reduced crude.

Products—Gas oil, gasoline, gas and coke.

Description—In the Delayed Coking Process reduced crude charge is heated and charged to the bottom section of the combination tower. Here aided by the partial pressure lifting effect of the coke drum vapors, light materials are removed from the charge. Tower conditions are so controlled that the bottoms mixture of virgin reduced crude plus coker recycle represents suitable heater charge material.

The design of a coking heater must be carefully worked out to prevent premature cracking which might occur, not at the outlet but at a point of lower temperature back in the heater, when handling heavy reduced crude.

The most important factor to be considered is the critical temperature zone, i.e., the zone at which a particular stock starts cracking and forming incipient coke. If the velocity and heat transfer criteria at this critical zone are properly set, coke formation will be kept to a minimum and long runs will be assured.

The liquid-vapor mixture leaving the coking heater passes to a coke drum. A unit usually has two drums, one of which is being filled while the other is being decoked. Large units may have four or even six drums. Under the conditions in the coke drum the heavy components in the charge are decomposed into coke and lighter components. The lighter components pass overhead from the coke drum as vapor and go to the bottom of the combination tower while the coke gradually fills the drum to the point where it must be taken off the line for cooling and decoking. The coke drums are most often sized so that each one operates on a 48 hour cycle thus permitting decoking of one drum to be scheduled at the same time each day on a 24 hour cycle. Decoking, which was done mechanically for many years is now done hydraulically in most installations.

The combination tower serves as a fractionator for both the fresh feed and the coke drum overhead, separating the total material into desired products and heater charge as described above.

Much of the heat removed from the combination tower can be recovered by the generation of high pressure steam which can be superheated, if desired, in a coil located in the convection section of the heater.

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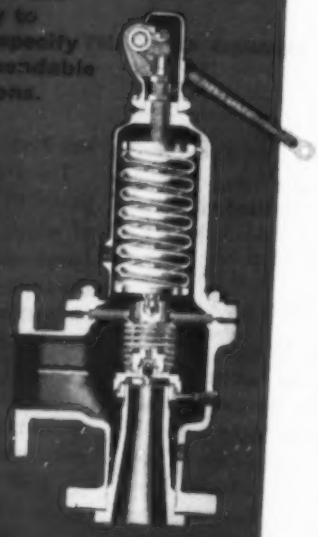
Bellows available in 316 Stainless or Monel, Kel-F seated if required.

Ask for additional data on this revolutionary, exclusive line of safety valves.



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FULL-NOZZLE

Sizes 1" D 1½", to 8" T 10"

SEMI-NOZZLE

Sizes 1½" F 2", to 6" S 8"

BAR STOCK & HI-PRESSURE

Type 2745—½", ¾", 1"
Type 2740—½" x 1", ¾" x 1", 1" x 1", 1" x 1½"
Type 1430—1¼", 1½", 2"

CORROSION TYPES

Type 1000—½" to 2"
Type 3725—½" to 1"
Type 3775—1½" to 2"

GENERAL SERVICES

Sizes ½" to 6" x 8"

REPRESENTATIVES IN U. S. AND CANADA:

TYPE 2680

Made in Series 30, 60, 90 and 150 inlet flanges, R.F. and R.T.J. Series 15 outlet standard. Available with "FarriSeal" or "BalanSeal" bellows—with or without internal heat exchanger coil; stainless steel, Monel and Hastelloy trim. Plain or packed cap, and open lever types.

TYPE 2610

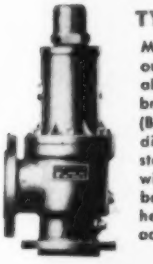
Made in Series 15 and 30 inlet flanges. Series 15 outlet standard. Parts interchangeable with heavy series valves. Full capacity, economical, for medium pressure range.

TYPES 2575 to 2578— Series A, B, C

A.S.M.E.—N.B. Steam Generator Safety Valve. Complies with A.S.M.E. Code for fired pressure vessels. The suffix A indicates maximum temperature of 650°. B indicates 750°, using alloy spring; C indicates 900°, using alloy spring and carbon-moly. body. Pressure limits:

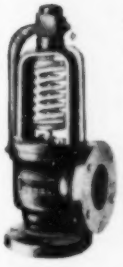
2575—300# 2576—450#
2577—600# 2578—900#

These valves are famous for their non-sticking qualities. Available in oversize orifices for greater capacity at slight additional charge.



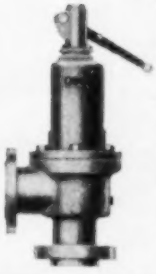
TYPE 2550

Made in Series 250 inlet, 125 outlet. Female outlet size available up to 4". Iron body, bronze or stainless steel trim. (Bronze trim has stainless steel disc as standard.) Stainless steel trimmed valves available with "FarriSeal" or "BalanSeal" bellows, with or without internal heat exchanger coil. Capacity advantages of full nozzle design



TYPE 2250

A.S.M.E.—N.B. Exposed Spring Boiler Safety Valve. 250# inlet, 125# female outlet to 4". Pressure and temperature limits 250# at 450°F. Available in stainless steel or bronze trim. Stainless disc on bronze trim, standard.



TYPES 2570 & 2550 - OL

Made in Series 250 inlet, 125 outlet. Female outlet size available up to 4". Iron body, bronze or stainless steel trim. (Bronze trim has stainless steel disc as standard.) Stainless steel trimmed valves available with "FarriSeal" or "BalanSeal" bellows, with or without internal heat exchanger coil. Capacity advantages of full nozzle design. Type 2550 - OL—Open Lever Construction; Type 2570—Packed Cap and Lever Construction.

TYPE 2745

Sizes ½", ¾" orifice No. 8 (area .019), No. 13 (area .077). 1" orifice No. 12 (area .045), No. 20 (area .250). By far the most outstanding advance in Safety Valve achievement. Nozzle capacity, blow down ring control, self aligning loose disc construction. Made from forged bar stock in four materials: brass, 304 and 316 stainless steel and cold rolled steel. Internal trim, 316 stainless steel. Both pipe connections in body for economical maintenance suitable for pressures to 10,000# on air, gas, oil and water. Type 2747—Packed Cap and Lever Construction.

TYPE 2740

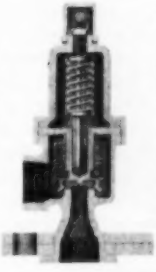
½" x 1", ¾" x 1" with .049 area, 1" x 1" and 1" x 1½" with .18 area. A rugged, simplified design, limited capacity Safety-Relief Valve. Used by refineries particularly where extreme accuracy of blow-down is not essential. Uses: thermal reliefs, pump by-passes, etc.

TYPE 1430

Sizes 1¼", 1½", 2" female inlet and outlet. Heavy duty Safety-Relief Valve, cast steel body, stainless steel trim, with flat seat and disc and blow-down ring for pressures up to 600#. Both pipe connections in body for economical maintenance. For gas or liquid service.

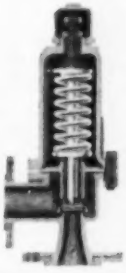
TYPE 1000

Diaphragm Control Relief Valve, sizes ½" to 2" male inlet, female outlet on bronze, 15 series inlet, 15 series outlet on Hastelloy "C" and type 316 stainless steel. Sensitive control with minimum bleed down. For chemical vapor-tight service—liquid or gas. Available with rubber, Neoprene, or molded Kel-F diaphragm and disc.



TYPE 3725

½" and ¾" orifice No. 13 (area .077). 1" orifice No. 20 (area .25). Made in female connections or Series 15, 30 or 60 flanges inlet. With rubber, Neoprene, or stainless steel "FarriSeal" bellows, Hastelloy "C" or 316 stainless steel body and disc. For highly corrosive acid services within the scope of 316 stainless steel and Hastelloy "C".



TYPE 3775

Sizes 1½" to 2", H orifice (area .785). Series 15, 30 or 60 inlet. Series 15 outlet. Rubber, Neoprene or 316 stainless steel "FarriSeal" bellows. Hastelloy "C" or 316 stainless steel body and disc. For highly corrosive acid services within the scope of 316 stainless steel and Hastelloy "C".

TYPE 1808

Sizes ½" to 2½". All Bronze Portable Pop Safety Valve. Male inlet, female outlet. A.S.M.E.—N.B. for steam or air services. Precise operation, economical first cost. Pressure to 250# steam.

TYPE 1400

Sizes ½" to 2½". Low Pressure Liquid Relief Valve, all bronze. Compact, adjustable range. Can be inspected and serviced without breaking pipe connection. Pressures to 250#.

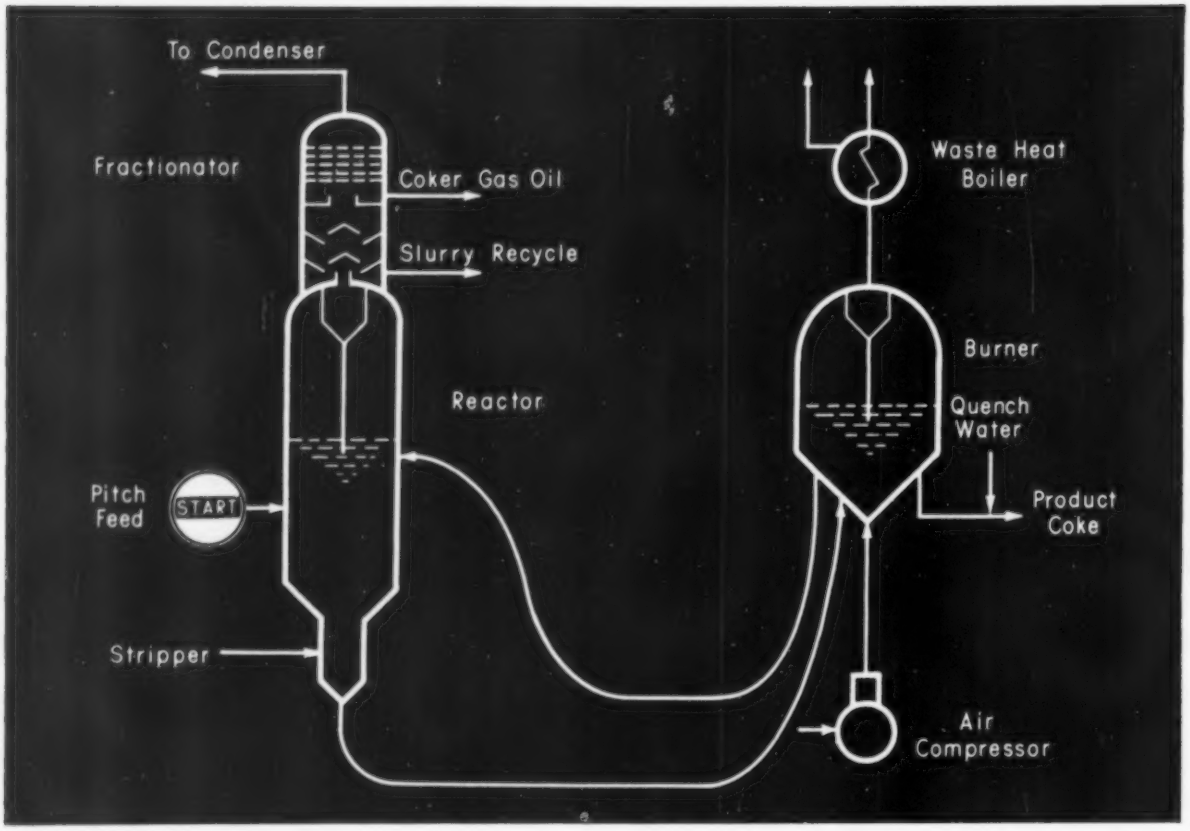
TYPE 2350

Sizes 1½" x 2" to 6" x 8". Wing guided construction cast iron body, bronze trim. A.S.M.E. — N.B. Boiler Safety Valve, exposed spring, test lever. 250# inlet, 125# or female outlet to 4"

TYPE 2469

Sizes 1½" x 2" to 6" x 8". Wing guided construction, enclosed spring, test lever. A.S.M.E. — N.B. Cast iron body, bronze trim, 250# inlet, 125# or female outlet to 4".

Albuquerque, N. M. Atlanta, Ga. Baltimore, Md. Birmingham, Ala. Bridgeport, Conn. Boston, Mass. Buffalo, N. Y. Calgary, Alta. Charlotte, N. C. Chicago, Ill. Cincinnati, O. Cleveland, O. Dallas, Tex. Denver, Colo. Des Moines, Ia. Detroit, Mich. Fort Worth, Tex. Houston, Tex. Indianapolis, Ind. Jacksonville, Fla. Kansas City, Mo. Kingsport, Tenn. Los Angeles, Cal. Memphis, Tenn. Milwaukee, Wis. Montreal, Que. New Orleans, La. Philadelphia, Pa. Pittsburgh, Pa. Providence, R. I. Portland, Ore. Richmond, Va. Salt Lake City, U. San Francisco, Cal. Seattle, Wash. Shreveport, La. Spokane, Wash. St. Louis, Mo. St. Paul, Minn. Toronto, Ont. Tulsa, Okla. Vancouver, B. C.



Fluid Coking—STANDARD OIL DEVELOPMENT COMPANY

Application—Fluid Coking is a new and flexible coking process for use in converting low-value crude oils and residual oils to more needed products—gasoline and home heating oil.

Charge—The process will handle atmospheric residua with initial boiling points as low as 600-700 F. or vacuum residua with initial points close to 1200 F. Feed stocks with gravities as low as 1.8° API and heavier or with Conradson Carbons as high as 35 percent have been processed. Indications are that any pumpable feed can be handled by this flexible process without much change in equipment.

Product—Normal products are naphtha, gas oil, coke and light gases. Clear octane number of the coker naphtha is about at the 77 CFR level, and presently available treating methods can produce satisfactory stability. As a cracking stock, coker gas oil is slightly poorer than virgin gas oil.

Description—The Fluid Coking process is a recent adaptation of the fluidized solids technique, first devised by Standard Oil Development in connection with Fluid Catalytic Cracking.

An example of how the process might be adapted for a typical refinery is shown schematically in the flow diagram. The unit consists essentially of a reaction vessel and a burner vessel. The feed stock is injected into a fluidized bed of coke particles in the reaction vessel. The temperature in this bed is uniform and may be in the range of 950 to 1050 F.

In the reactor the feed is substantially completely converted into overhead vapor and coke; the latter deposits on the coke particles already there. The vapor products are taken overhead through a cyclone separator which removes entrained coke and returns it to the reaction zone. The overhead product then passes to conventional separation equipment and a small amount of recycle bottoms is returned to the reactor.

The heat for carrying out the coking is generated in the burner vessel. A stream of coke particles is transferred like a fluid through a standpipe-riser system to the burner vessel. Air is supplied to burn enough of the coke to provide the heat for the process. The hot coke carries heat back to the reactor, completing the continuous circuit. The net coke produced is withdrawn continuously to maintain the proper inventory in the system.

Yields—Typical yields from recycle coking are the following:

Feed: Vacuum pitch from South Louisiana Crude 13° API; 14 percent Conradson Carbon	
Dry Gas, Wt. Percent	8
Naphtha, Vol. Percent	24
Wide-cut Gas Oil, Vol. Percent	61
Coke (Gross), Wt. Percent	16

The wide-cut gas oil (430/1015 F.) is available as catalytic cracking feed. If desired a home heating oil cut can be taken directly from this stream.

Commercial Installations—Already announced are three units to be built in the U. S. The first commercial installation, now being built, will be at the Billings, Mont., refinery of The Carter Oil Company. This is a 3800-barrel-per-day unit, scheduled for operation in late 1954. Esso Standard Oil Company plans to follow about a year later with a 10,000-barrel-per-day unit at Baltimore and then a 21,000-barrel-per-day unit at Baton Rouge, La.

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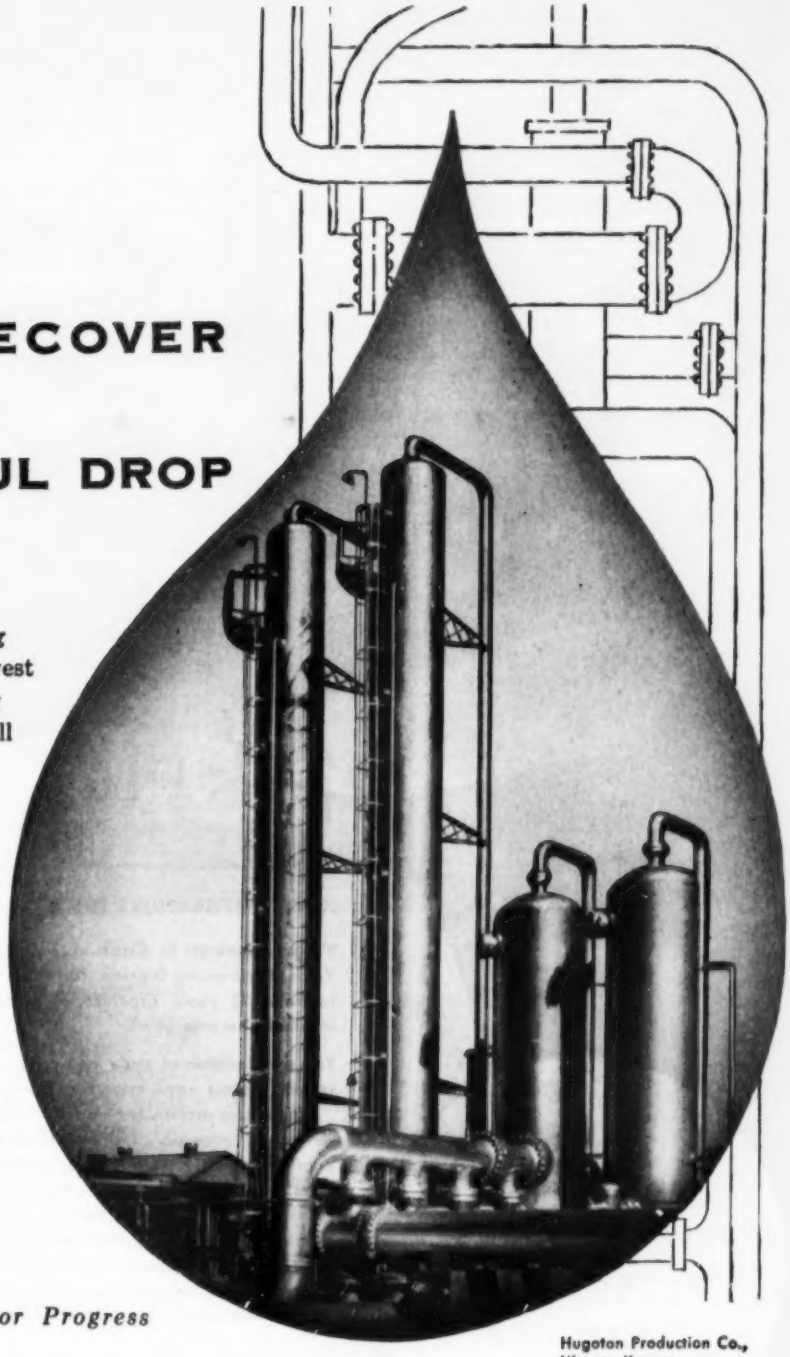

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Whether your particular chemical process problem is of broad or limited scope, it will be worthwhile to review it in terms of one or more of these Vulcan services:

- Economic and technical surveys
- Preliminary process evaluations
- Process development
- Pilot plant studies
- Process and plant design
- Equipment design and procurement
- Construction and erection
- Initial operation services

. . . or the full integration of all these services in the design and building of complete process units or plants.

. . . THE IMPLICATIONS FOR YOUR ORGANIZATION

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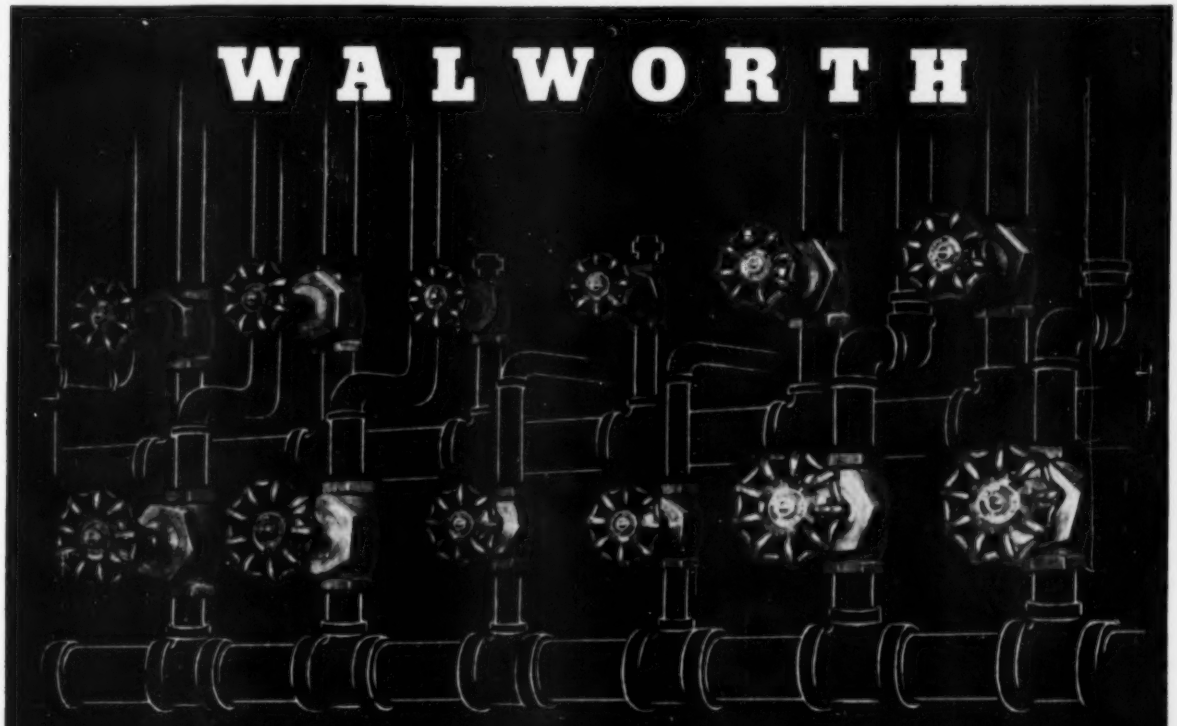

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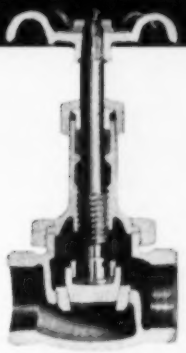

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Light Hydrocarbon Recovery Processes

Application—Light hydrocarbon recovery processes are applied to refinery gas recovery and gasoline stabilization. The initial refinery application, the setting of gasoline vapor pressure in fractionating column stabilizers, continues to be a major refinery process operation though vapor recovery and fractionation units are now among the essential secondary refinery processes.

Such plants found initial refinery applications as accessories to early thermal cracking units. In many of these cracking units, gas and gasoline were separated at near atmospheric pressures under equilibrium conditions, so that large volumes of valuable butane-and-heavier components were not condensed to liquid. The widespread adoption of the catalytic cracking processes resulted in increased installation of gas-concentration and stabilization facilities for the two-fold reason that catalytic-cracking plants produce large quantities of pentane and lighter materials and that these plants must of necessity fractionate the reactor effluent at low pressure.

Practically all refineries in operation today include some form of gas-recovery and fractionation plant. Their design depends upon the type of refinery process units employed and the amounts of wet gas and unstable distillates to be handled. Each refinery situation requires special consideration.

Charge—Unstable distillates and wet gases from refinery process units.

Products—Gasoline, butylene, butanes, propylene, propane, ethane and methane.

Description—Recovery unit designs vary widely with the desired retention and separation of vapor components. Methods for separation include: (1) fractionating absorbers, (2) low temperature fractionation and (3) adsorption. The most popular method in modern plants is the fractionating absorber as illustrated in the upper flow diagram.

The cracking plant effluent is charged to a main fractionator on which the end point gasoline and all lower boiling components in the product are taken overhead. The liquid overhead is pumped and the gas compressed into a fractionating absorber. In this column, a separation is made between propylene and ethane. The lean oil used is depentanized gasoline from the bottom of the next column; this stream recycling through the two columns. Very high propylene recoveries with little ethane contamination can be obtained. The operation of these units is very satisfactory, the major problem being the fouling of the deethanizing column with contaminants present in the feed.

The lower diagram represents an application of the refrigeration or low-temperature fractionation process. This plant receives gas and gasoline from a catalytic cracking unit and from a catalytic treating unit.

Motor gasoline from the cracking plant is charged to the debutanizer. This column is operated at 185 psig to effect recovery of the major portion of the overhead as liquid. Debutanized gasoline goes to storage.

Aviation gasoline from the treating unit is stabilized at approximately the same pressure, also to obtain maximum recovery of the overhead as liquid, and the stabilized gasoline is pumped to storage. The liquid overhead products from the debutanizer and stabilizer are pumped to a surge tank from which they are sent to the de-ethanizer.

Cracking-unit gas is received at 50 psig. The smaller amount of treating-unit gas, available at lower pressure, is compressed to 50 psig, and these streams are combined with the small flow of overhead gas from the debutanizer and stabilizer, compressed, and discharged into the de-ethanizer which operates at 450 psig. The overhead from this column at 125 F. is water-cooled and then refrigerated, providing reflux at a temperature of 45 to 50 F. The possibility of hydrate formation precludes the use of lower temperatures. The refrigeration unit uses propane as the refrigerant. Refrigeration is effected by the evaporation of plant propane in a kettle-type tubular unit. The propane vapor so produced is compressed and then condensed in the depropanizer overhead product condenser. Net de-ethanizer overhead product gas goes to plant fuel.

De-ethanizer bottoms are depropanized 250 psig. In this column, commercial propane is produced overhead. The bottoms are sufficiently depropanized so that the subsequent butane product will contain less than 1 mol percent propane. The butane tower operates at 100 psig and is designed to make a sharp separation between normal butane in the overhead and isopentane in the bottoms. The bottoms from the butane tower is feed for the isopentane column. This column, operating at 22 psig, is designed to produce overhead and isopentane fraction of 98 percent purity. The bottoms from the isopentane column comprising normal pentane and heavier are pumped to storage and used in motor-gasoline blends. Although two isopentane towers are shown in the flow diagram, it will be noted that process-wise they actually constitute one tower. A split tower was used since the height of a single tower would have been excessive for this particular installation.

For separation and recovery of low concentration gases, the Hypersorption (Union Oil Company of California) process represents an entirely different approach. This adsorption process (no diagram shown) is applicable to the separation and recovery of hydrogen, nitrogen, acetylenes, methane, ethane and ethylene, propane and propylene.

The process employs a moving bed of activated charcoal to adsorb and fractionate components of a gas stream. Feed gas enters through a distributor and flows upward countercurrent to the moving bed of charcoal. Heavier components are preferentially adsorbed and retained on the charcoal while the lightest components disengage at the cooling zone at the top of the tower, and pass off.

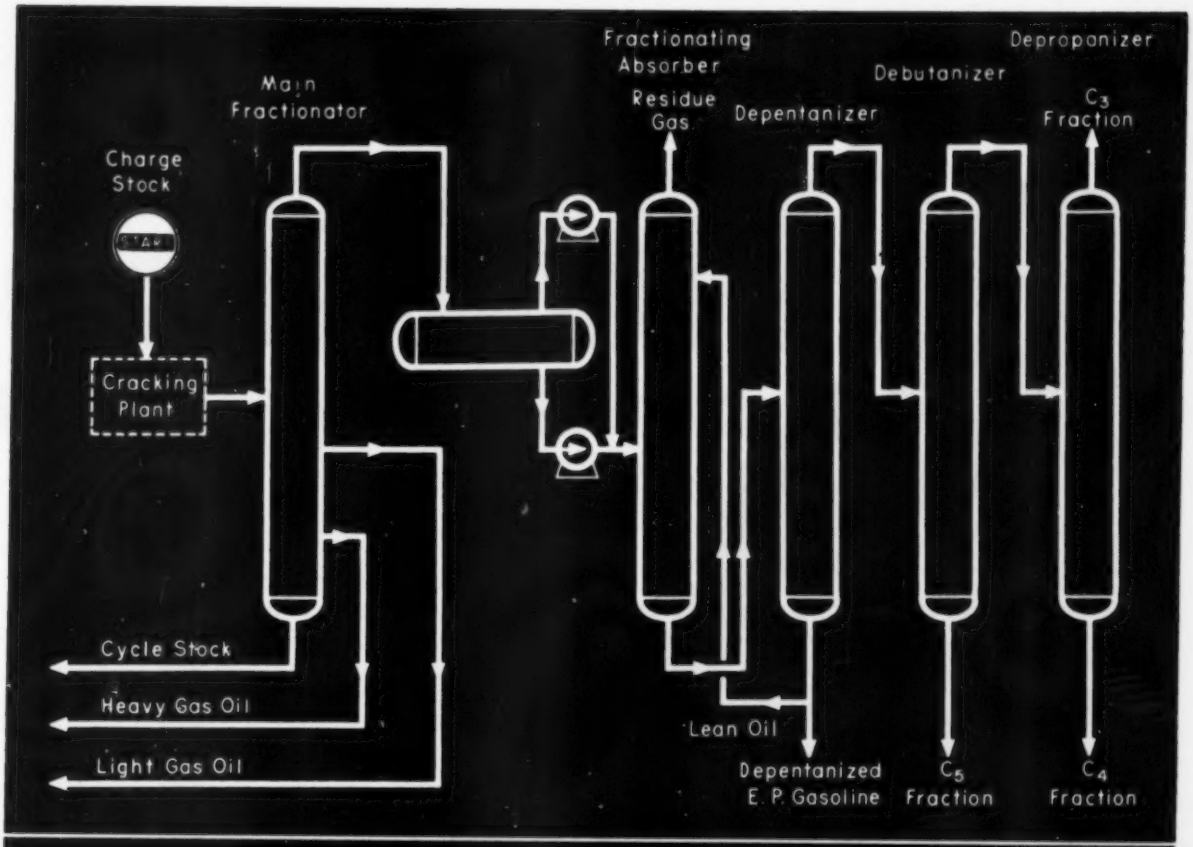
As the charcoal passes downward it is increasingly subjected to a reflux of heavy constituents separated in the stripping zone, which serves to liberate lighter constituents adsorbed on the downward-moving charcoal. A concentration of these latter in the vapor phase results and if desired can be disengaged as a side-cut product gas between the feed and bottom product disengaging sections.

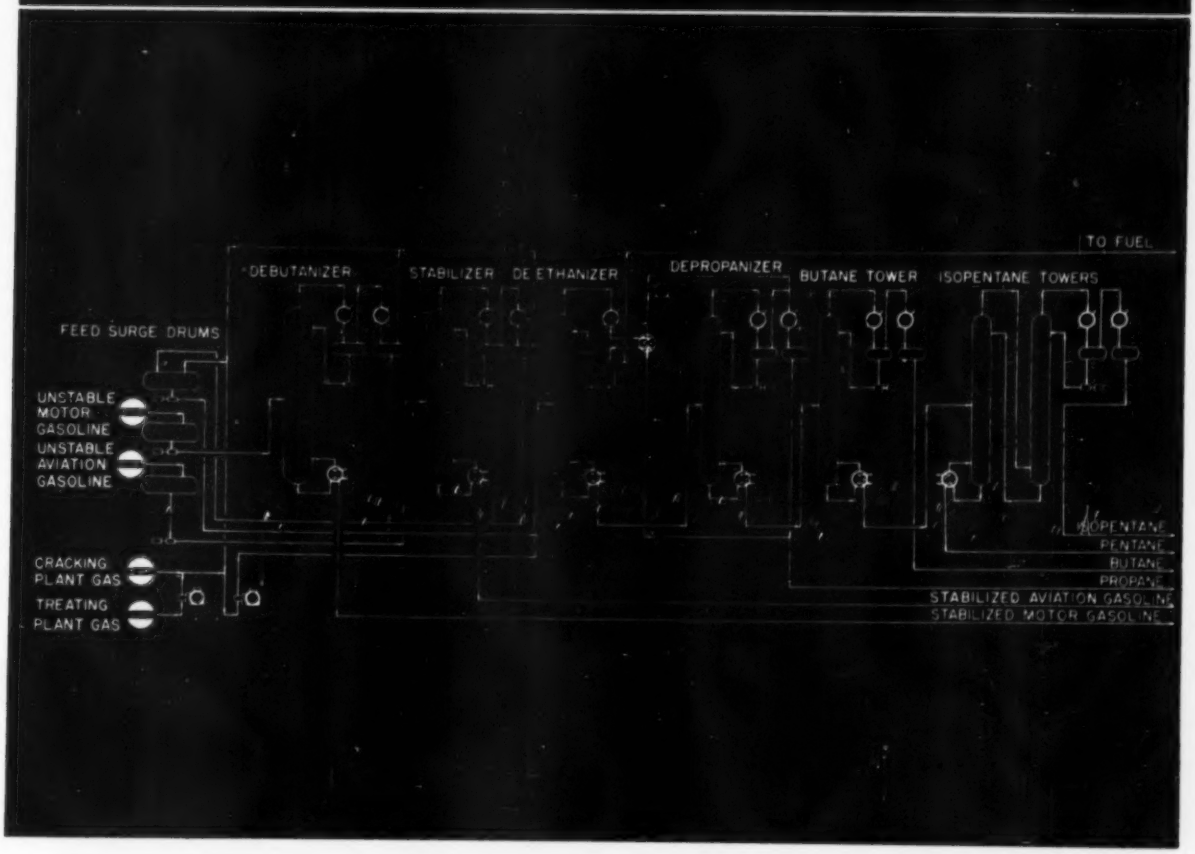
As the charcoal flows past the bottom product disengaging section into a steaming section, it meets an upward flow of steam which liberates the adsorbed heavy components, and these flow upward either to return as reflux or pass out as bottom product.

The charcoal flows from the steaming section into a stripping section wherein it passes down through tubes heated by a circulating heat-transfer medium and through which the steam has passed countercurrent to the charcoal. This section effects the removal of substantially all adsorbed residual material.

The charcoal is transported to the top of the tower by means of a gas lift system, thence into the cooling section wherein the charcoal is cooled to the desired temperature for adsorption.

When necessary a regeneration system is provided to reactivate a side stream of charcoal. This operation is performed at high temperature using steam.


Fractionating Absorber
Depropanizer
Main Fractionator
Debutanizer
Residue Gas
Depentanizer
C_3 Fraction
Charge Stock
Cracking Plant
Cycle Stock
Heavy Gas Oil
Light Gas Oil
Lean Oil
Depentanized E. P. Gasoline
C_5 Fraction
C_4 Fraction


TO FUEL
DEBUTANIZER
STABILIZER
DE ETHANIZER
DEPROPANIZER
BUTANE TOWER
ISOPENTANE TOWERS
FEED SURGE DRUMS
UNSTABLE MOTOR GASOLINE
UNSTABLE AVIATION GASOLINE
CRACKING PLANT GAS
TREATING PLANT GAS
ISOPENTANE
PENTANE
BUTANE
PROPANE
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STABILIZED MOTOR GASOLINE

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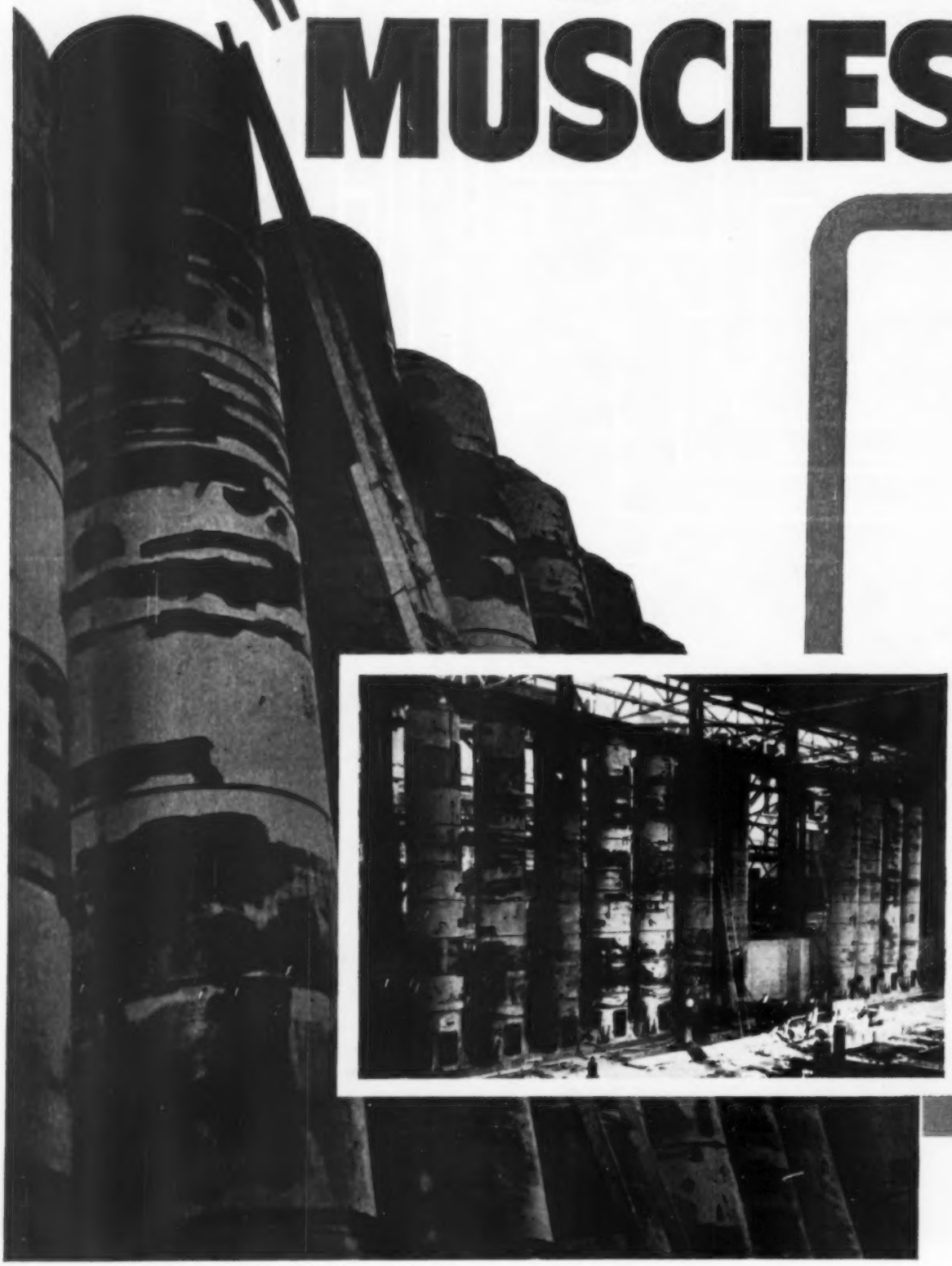

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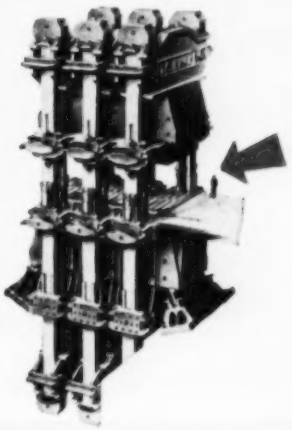

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S-429

California Polymerization—CALIFORNIA RESEARCH CORPORATION

Application—The process is used: (1) to produce high octane polymer gasoline from olefins, or (2) to produce cumene from benzene and propylene.

Charge—The motor polymer process is equally applicable to total gas feed such as is obtained from cracking or reforming plants, or to a liquid stream containing propene or butenes, or mixtures of both. The cumene process uses benzene and a gas or liquid stream containing propane and propene. In all cases, the feed is caustic washed for the removal of H_2S and mercaptans and water washed for removal of nitrogen compounds.

Product—The F-1 clear octane rating of the polymers is in the range of 93 to 99 the F-2 clear in the range of 80 to 85, and blending values in the order of 115 to 120.

Description—In the reaction section, part of the fresh feed, either liquid or vapor, is preheated to about 300 F. by exchange with reaction mix coming from the reactor at 375 F. to 400 F. and is introduced into the top of the reactor. Polymerization of olefins is highly exothermic; and the temperature is limted to a maximum of 400 F. by the introduction of the balance of the cold feed through quench points appropriately located in the reactor. Reaction mix from the bottom of the reactor flows through a small vessel packed with limestone for removal of traces of acid which might be present, exchanges with the top reactor feed, then flows to the product recovery section.

Preparation of the catalyst is simple. The reactor is first packed with fine mesh quartz supported by larger size quartz in the bottom of the reactor. The reactor is filled with phosphoric acid and the excess drained off. A thin film of phosphoric acid is left on the quartz surface. To regenerate, the reactor is washed with water, steamed, and dried. After filling with phosphoric acid and draining off the excess acid, the reactor is then ready to go back on stream. This procedure can be completed in about 30 hours. In liquid feed operation, a catalyst life of at least 100 gallons of polymer per pound of phosphoric acid is obtained.

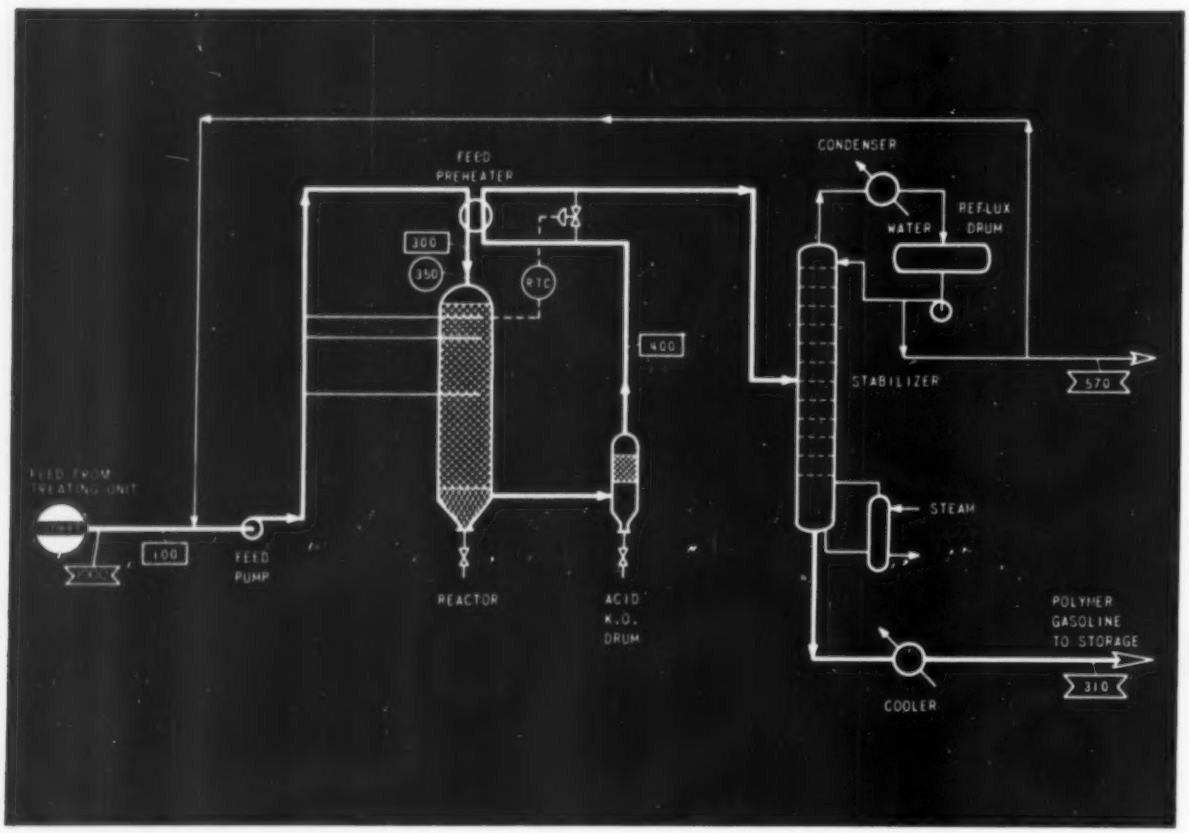
Operating Conditions—The motor polymer process is carried out between 300 and 400 F. and at pressures from 150 to 600 pounds. When the feed contains very high concentrations of olefins, a diluent (usually stabilizer overhead liquid) is added to provide sufficient heat capacity to absorb the heat of reaction.

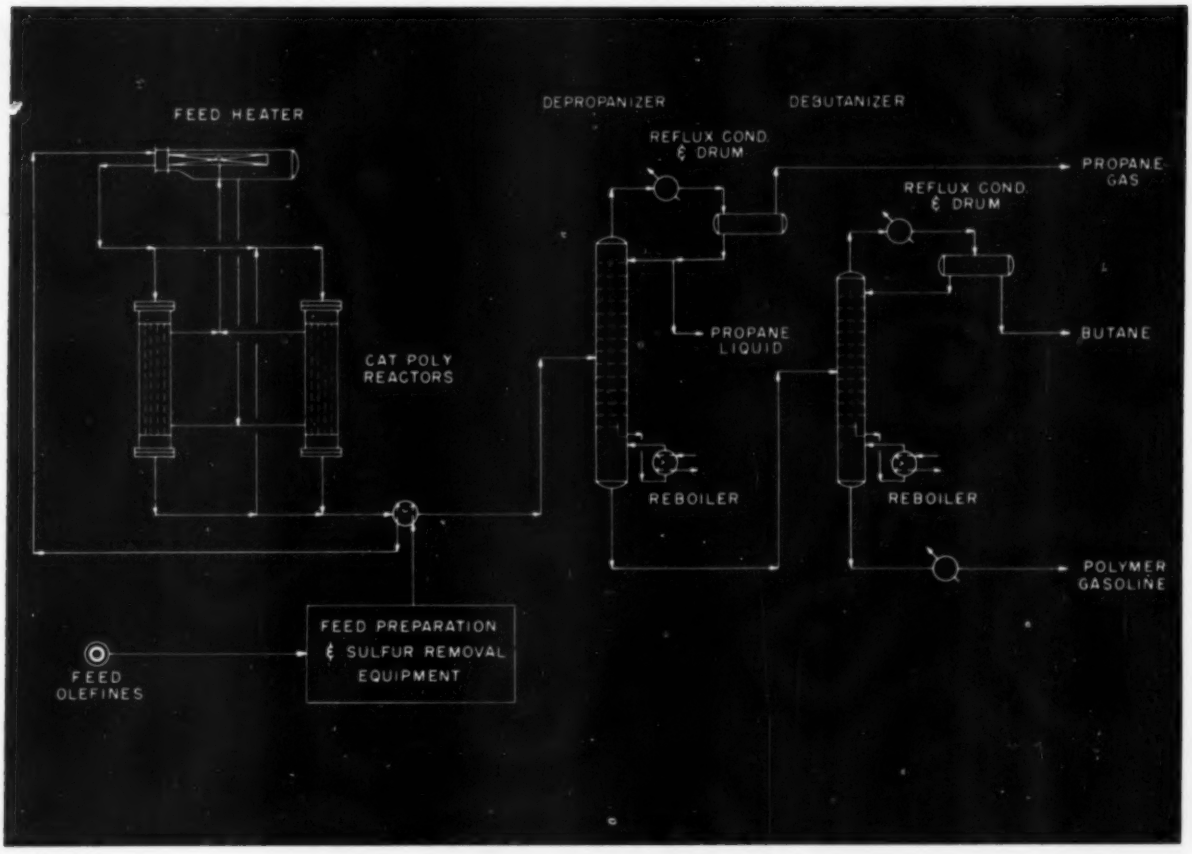
Yields—Conversions of 90 to 95 percent of the olefins are obtained. The table shows typical product properties:

	Propene[1] Polymer	Butene[2] Polymer
Gravity, °API	56.9	59.7
Reid Vapor Pressure, psi	0.5	2.0
Octane Number:		
F-1 Clear	93	99.0
F-1 + 3 ml TEL	99	Isooctane + 0.18
F-2 Clear	80.5	81.0
F-2 + 3 ml TEL	85.0	84.2
ASTM Distillation, F:		
IBP	222	140
10 Percent	267	211
50 Percent	311	242
90 Percent	381	361
End Point	408	443

[1] Debutanized and rerun (95 percent rerun yield).
[2] Debutanized.

Commercial Installations—Since the first unit was built in 1937, seventeen other units are in operation and 13 others are under construction. The process is also licensed by Hydrocarbon Research, Incorporated.





Catalytic Polymerization—THE M. W. KELLOGG COMPANY

Application—The process is applied for chemically uniting propylenes and butylenes to produce a high-octane gasoline component.

Description—The liquid stream of C_3 and C_4 hydrocarbon reactants from the gas-recovery system is first treated to remove hydrogen sulfide and then washed with caustic to remove mercaptan sulfur. It is then heated to 300-400 F. and introduced into the reactor which is kept at about 900 psig to maintain the material in the dense phase.

After the reaction occurs, the reactor effluent proceeds to conventional stabilizing equipment as follows:

The hot product gases leaving the reactor exchange a portion of their heat to the incoming charge and then pass to a depropanizer where propane and any unconverted propylene is routed either to plant fuel or to bottled gas. The depropanized product flows to a debutanizer where butanes are removed, leaving the high-octane polymer gasoline as the bottom product. The butanes produced are used for motor-fuel-blending purposes.

A common type of reactor is the tubular reactor which is essentially a heat exchanger in which the tubes are filled with catalyst and surrounded by a bath of water and steam which is circulated to remove the heat of reaction. The reaction temperature is automatically controlled. Chamber-type reactors are also used with catalyst supported on screens and heat of reaction removed by recycling saturated hydrocarbons from the first tower (not illustrated).

Operating Conditions—Essentially there are two types of operation, depending on the feed stock.

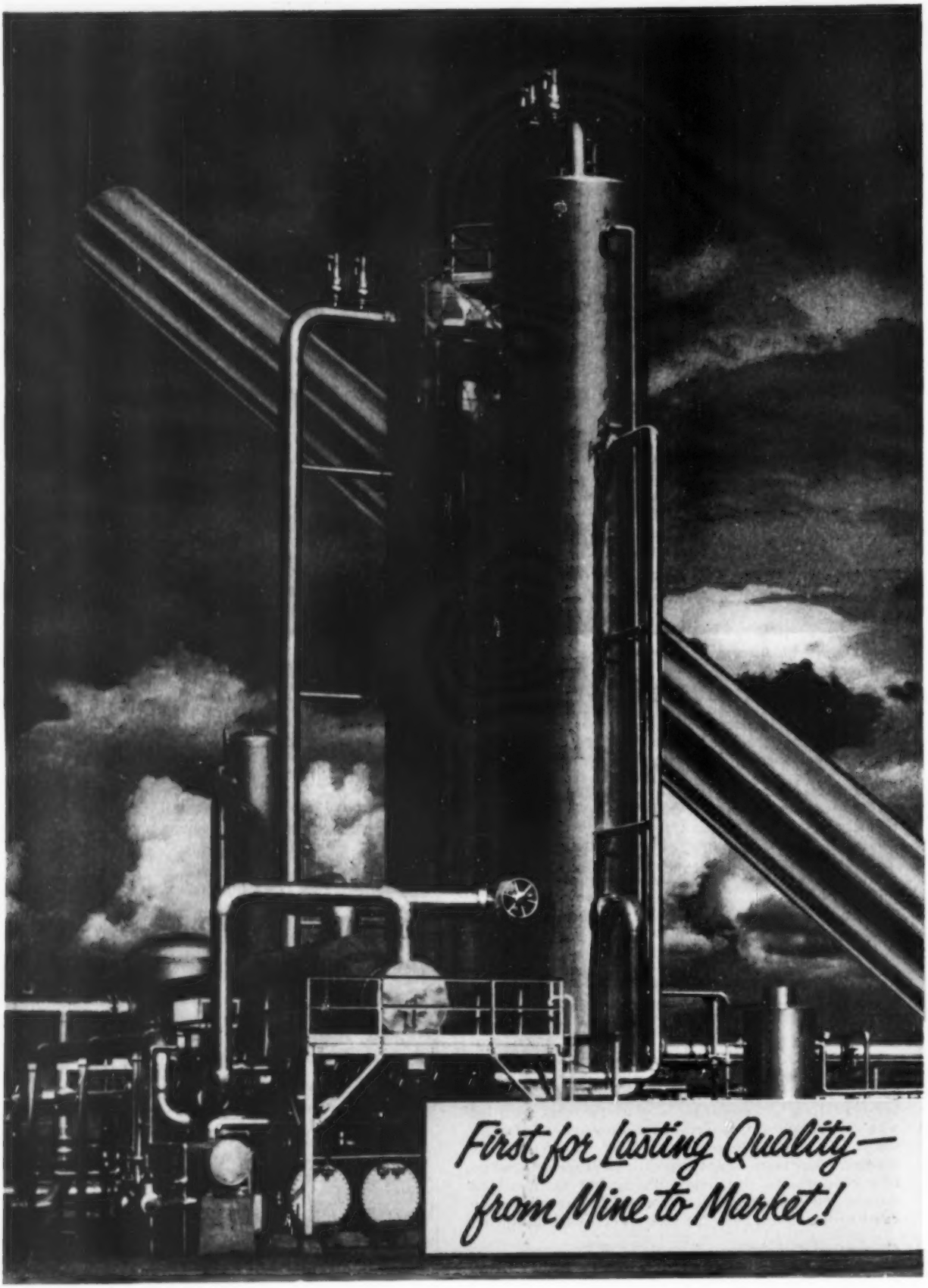
(a) *Codimer Operation*, which is polymerization of butylenes only and which uses a hydrocarbon feed stock of essentially 100 percent C_4's. The operation usually is carried out at temperatures on the order of 300 F. The product, called codimer, is unsaturated, but when hydrogenated has a clear ASTM octane number on the order of 95 and is, therefore, a very acceptable component for aviation gasoline.

(b) *Motor Fuel Operation*, uses for a feed stock mixtures of C_3's and C_4's and the operation usually is carried out at approximately 375-400 F. The polymer is unsaturated and has a clear octane of about 83 ASTM and 96-98 CFRR. Its blending value, however, is considerably over 100 by either rating method when the percentage in the blend is not more than 10 or 15 percent.

The catalyst employed in Kellogg units is copper pyrophosphate. It has a normal life of 100-150 gallons of polymer per pound of catalyst.

Yields—The table below gives typical results of both types of operation.

	Codimer Operation	Motor Fuel Operation
Conversion, percent of Olefin	80	90
Octane No.—ASTM Clear	95	83
Octane No.—CFRR Clear	....	96-98
RVI of Polymer, psi	2.0	2.0
IBP of Polymer, °F.	148	170
EP of Polymer, °F.	421	431
Gravity of Polymer, °API	60.4	60.1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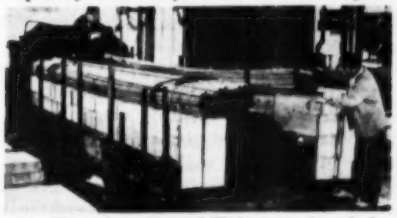

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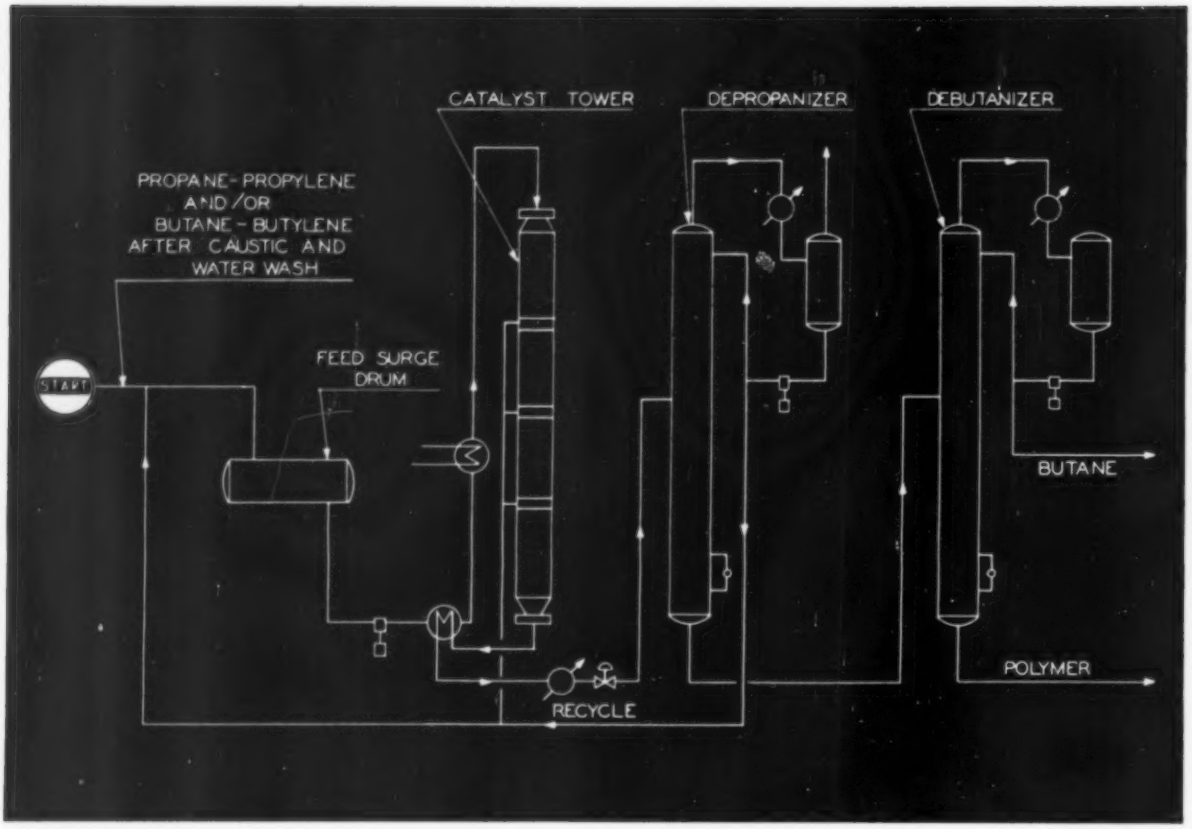


Catalytic Polymerization—UNIVERSAL OIL PRODUCTS COMPANY

Application—The process offers a means for converting a portion of fuel gas produced in cracking operations into a high-grade motor gasoline that has an F-1 clear octane of 95 or better.

Product—In the production of aviation gasoline, polymerization of the butylenes in the absence of other olefins can be controlled to yield a product which on hydrogenation will rate up to 95 clear F-1 octane number. This is referred to as a selective polymerization operation used to produce aviation gasoline components. Polymerization of propylene and butylenes in a mixture for the production of a fuel which will be blended in motor gasoline is referred to as a non-selective operation. This is the most common of all polymerization operations.

Propylene can also be polymerized separately to make either a motor polymer or C_{12} polymer. C_{12} or "Tetramer" is one of the raw materials for many detergents. This same poly unit can be used for alkylating propylene and benzene for the production of cumene, which is a raw material in making phenol.

Description—The polymerization operation is one which consists of contacting the olefin-containing feed stream with the catalyst at temperatures in the range of 350 to 425 F. and at pressures ranging from 250 to 1200 psi. Processing conditions vary with the type of plant employed, with the feed stock processed, and with the type of product desired.

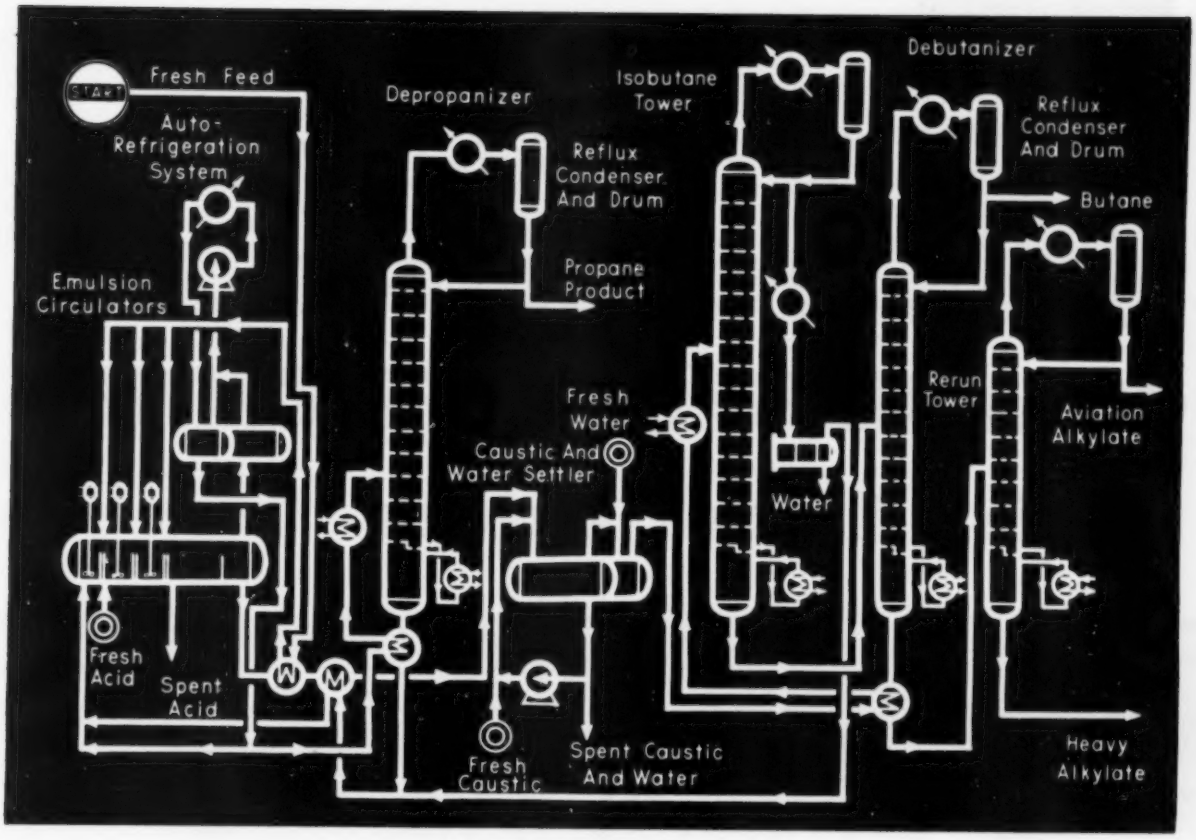
There are two types of units now being used for carrying on the process of polymerization. The most commonly used design is known as a chamber type shown in the diagram. In this unit the catalyst is contained in a vertical chamber. Catalyst is loaded in one or more chambers, each containing multiple catalyst beds of 2 to 8 feet in depth.

Since the polymerization reaction is exothermic and the system in which the reaction takes place is essentially adiabatic, the temperature of the reactants increases as they travel through the catalyst beds.

In order to keep the temperature rise through the catalyst beds at an optimum for good olefin conversion and catalyst life, it is desirable to control the amount of reaction that occurs in the catalyst chamber by the recycling of hydrocarbons which have been through the catalyst chambers. This recycle material, being low in olefin content, will act to dilute the olefins in the fresh feed. In order to hold a given temperature at the inlet to each bed a liquid quench is injected between beds. This quench usually consists of C_3 or C_4 hydrocarbons which have already been through the unit and are low in olefins.

The reactor type of unit employs heat exchanger type reactors. In this design the catalyst is loaded in vertical small-diameter tubes which are surrounded with a cooling medium to remove heat of reaction.

Reactor type units are most commonly used when the feed to be processed is high in olefin content such as is the case for C_3 and C_4 fractions produced from catalytic cracking.



Catalytic Alkylation—THE M. W. KELLOGG COMPANY

Application—The process is applied to the production of alkylate as a high-octane blending agent in aviation and motor gasoline.

Charge—Isobutane with olefinic light hydrocarbons. While the most common case is the combination of isobutane and butylene, propylene and pentylene have also been combined with isobutane.

Product—The octane rating (F-4 at 4.6 cc TEL) of the alkylate ranges from 140 to 160.

Description—In this process, the liquefied gases are introduced into a reaction chamber in the presence of concentrated sulfuric acid (98 percent) which acts as a catalyst. During the reaction, which generally proceeds at a temperature between 38 and 40 F., the sulfuric acid drops in concentration due to dilution by moisture in liquefied gas stream and side reactions with "impurities" in the feed and is withdrawn. This is customarily at a concentration of about 90 percent, though it is widely variable. Fresh acid is regularly introduced to keep the quantity and concentration of acid in the reactor constant.

Since the reaction is exothermic, the heat of reaction is removed by auto-refrigeration. To permit continuous vaporization, a portion of the vapors is withdrawn from the top of the reactor. This gaseous fraction is compressed, condensed and returned to the reactor.

The product of the reaction is passed through a caustic wash and then to the isobutane tower. The isobutane overhead from this tower is returned to the process while the alkylate bottoms containing any normal butane present in the original feed is sent to a debutanizer tower where butane is removed as an overhead product. The alkylate bottoms are separated in a rerun tower into a light aviation alkylate and heavy alkylate.

Some refiners, primarily those who use large quantities of acids, find it economical to recover spent-acid in special equipment and concentrate it for re-use in their alkylation operation. A different situation is encountered where the refiner has an immediate secondary use for spent-acid, i.e., the acid treating of lube oils. In this case, one can say that the alkylation operation consumes no acid from an overall refinery economic standpoint.

Operating Conditions—The major factors affecting product quality and other operating results are reaction temperature, olefin concentration, isobutane concentration and acid strength.

Yields—The table below gives typical yields and inspections:

OLEFIN FEED	C_3	C_4	C_5
Alkylate Yield:			
Vol. Percent on Olefins	175	172	155
Acid Consumptions (Approximate):			
Lb./Gal. Total Alkylate (98 Percent Fresh—90 Percent Spent)	2.0	0.6	1.0
Octanes—Aviation Alkylate:			
ASTM Octane No. Clear	90	94	91
F-3 or 1-C Octane No. + 4.6 cc TEL	106	108	107
F-4 or 3-C Blending Index No. + 4.6 cc TEL	140-145	155-160	145-150

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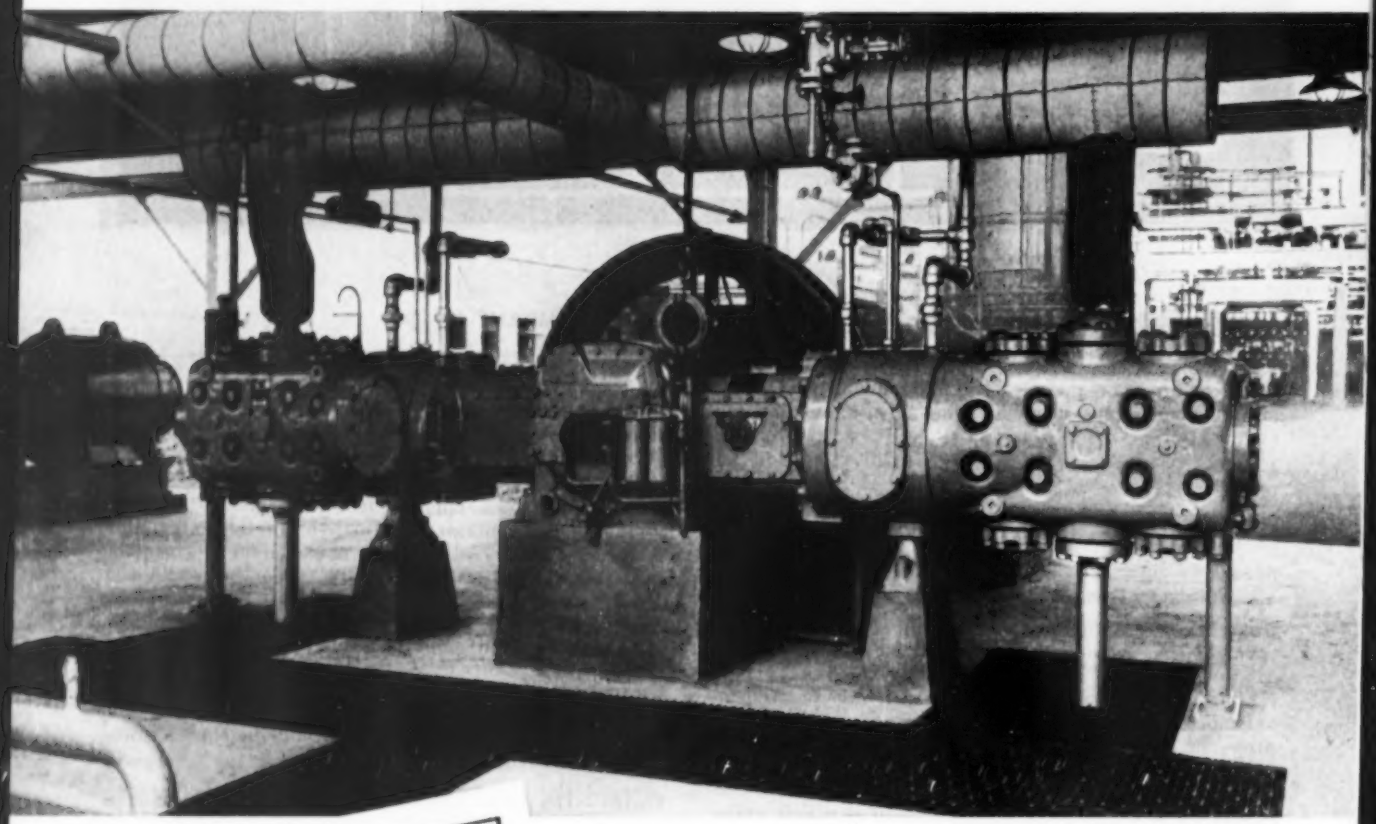

One of the two Cooper-Bessemer EM compressors, rated at 300 hp, serving in Canadian Oil's UOP Platforming operation. Note the simple, neat and compact arrangement of this "open air" unit.

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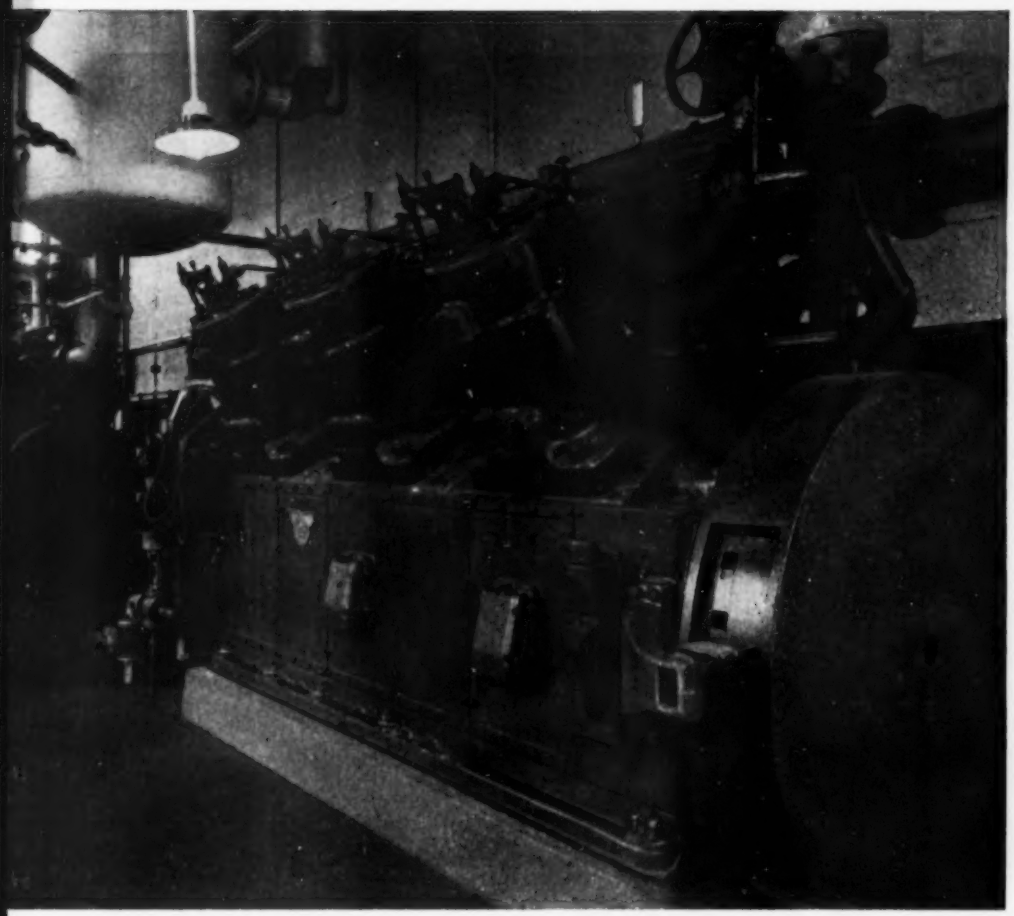

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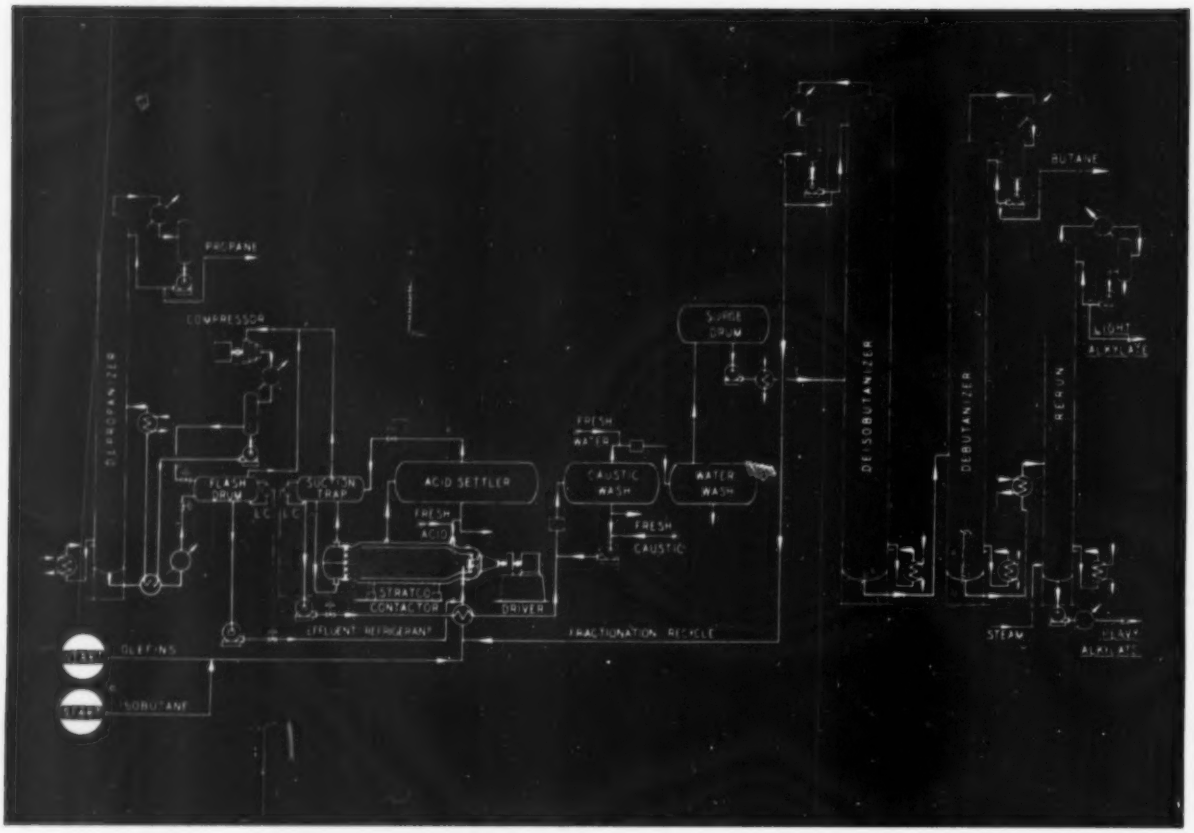


Effluent Refrigeration Alkylation—STRATFORD ENGINEERING CORPORATION

Application—The process combines normally gaseous olefinic hydrocarbons such as propylene, butylene, and amylene with isobutane to produce high octane branched chain hydrocarbons (alkylate) for use in aviation gasoline and motor fuel blends.

Charge—When the alkylate is for use in high grade aviation fuel the olefins must be principally butylenes although some propylene and amylenes may be included. For use in motor gasoline the olefins may be propylene, butylenes or amylenes separately or in any combination.

Product—When the olefins charged are substantially all butylenes the 338° F end point debutanized light alkylate will show a 3-C performance number (with 4.6 cc TEL) of 155 to 160.

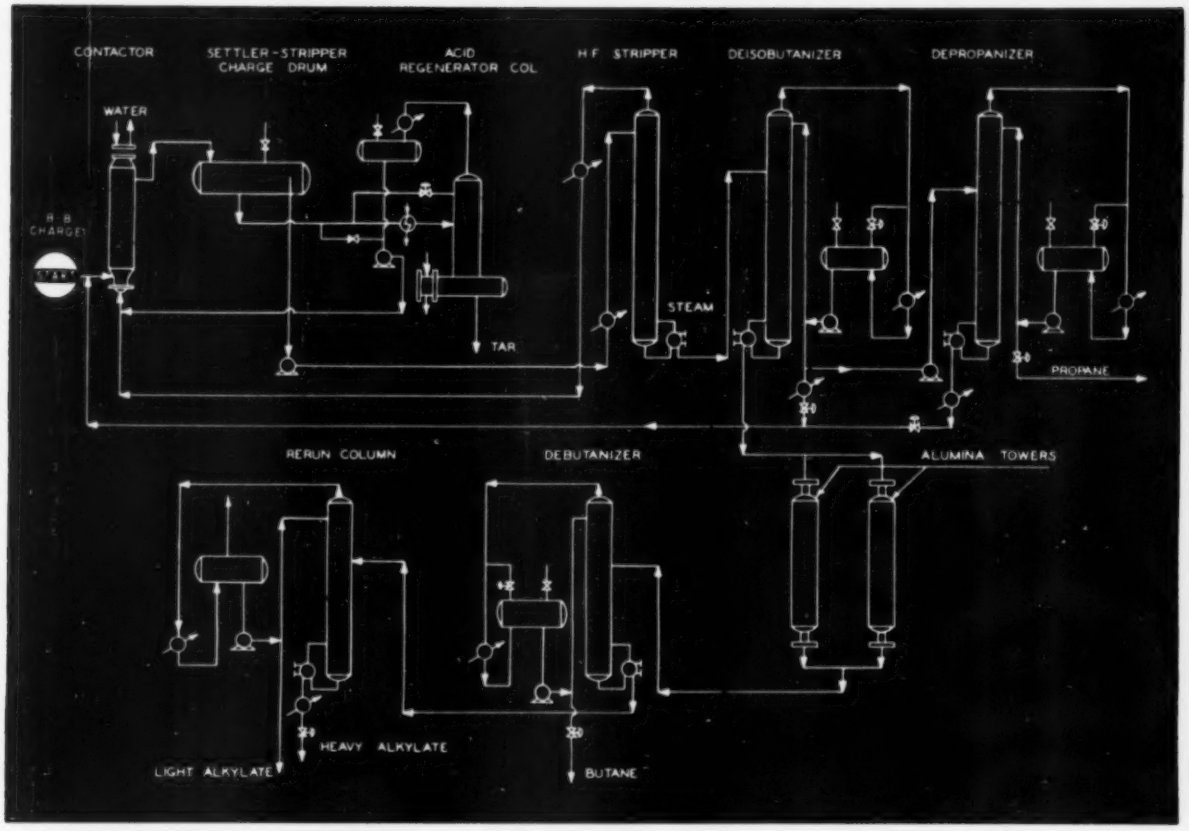
Description—After heat exchange the feed streams along with a recycled stream of sulfuric acid are charged to the contactor type reactor. Within the reactor the acid hydrocarbon mixture is circulated at a rate of 40,000 to 50,000 gpm. The isobutane content of the large circulating stream produces an internal isobutane olefin ratio at the point of olefin injection normally ranging from 400:1 to 800:1.

The acid-hydrocarbon mixture leaving the contactor is passed to the settler where it is separated into an acid phase which is returned without a pump to the suction side of the contactor impeller, and a hydrocarbon phase which leaves the top of the settler.

The hydrocarbon effluent passes a back pressure regulator and is discharged into the refrigerant suction trap. The reduction in pressure results in partial vaporization and cooling of the effluent mixture. The cooling elements of the contactor are kept flooded with a recycle of the cold liquid from the suction trap by means of thermosyphon and gas lift flow. In some cases the total chilled effluent after passing the back pressure valve is put directly through the cooling elements before being introduced into the suction trap. Additional isobutane is vaporized in the contactor tube bundle and the total refrigerant vapor is compressed and condensed. After depropanization and cooling by flash vaporization the "effluent refrigerant" is returned to the contactor. The overhead from the deisobutanizer tower and the effluent refrigerant recycle together constitute the total isobutane recycle to the reaction zone. Of the total isobutane recycled normally between 60 and 70 percent is supplied by the effluent refrigeration system. No portion of this refrigeration recycle is permitted to vaporize in the reactor. The total increased quantity of isobutane is present in liquid phase throughout the entire reaction zone thereby serving to promote the alkylation reaction to the same extent as equivalent isobutane from a deisobutanized tower. Isobutane concentration in the hydrocarbon phase leaving the reactor normally ranges between 63 and 72 volume percent.

Since a major portion of the hydrocarbon effluent is removed as vapor from the suction trap by the refrigeration compressor only part of it remains as a liquid to be passed to fractionation and the load on the deisobutanizer tower is small. Excellent results are obtained when the tower furnishes only 2 to 3 volumes of isobutane recycle per volume of olefin in the feed. Bottoms from the deisobutanizer tower are debutanized and the resulting total alkylate is subsequently rerun to the proper overhead end point.

Commercial Installations—The first commercial plant started operation in February, 1954. Several new units are under construction.



HF Alkylation—UNIVERSAL OIL PRODUCTS COMPANY

Application—The process is a catalytic method which combines olefins, such as propylene, butylenes, and amylenes with an isoparaffinic hydrocarbon, usually isobutane, to form a mixture of branched chain hydrocarbons of higher molecular weight known as alkylate.

Product—The alkylate so produced is a mixture of saturated, stable isoparaffinic hydrocarbons distilling in the gasoline range. When operating at the lower temperatures the performance numbers reach 133 F-3 with 4.6 cc TEL and 153 F-4 with 4.6 cc TEL. Because of its high octane number, the alkylate is used as the main component of 115-145 aviation gasoline as well as of 100-130 aviation gasoline. The high quality of the product and the ability of the process to convert not only the gaseous olefins but also approximately an equivalent amount of isobutane into a blending component of gasoline boiling range makes the process of great utility to the refiner. Besides high grade aviation gasoline, the alkylate is being used as a blending component for maximizing the quantity and quality of motor fuel, as well as consuming all refinery isobutane which allows the purchase of maximum natural gasoline for motor fuel vapor pressure control.

Description—The process is carried out essentially as follows: Fresh feed, prepared by absorption and fractionation of the light gases from catalytic cracking and related processes, is dried by fractionation or by means of a desiccant. The stream then combines with the isobutane recycle and flows through the reactor which is essentially a heat exchanger partially filled with HF acid. Sufficient pressure is used to keep the mixture in liquid state. Normally, the ratio of acid to hydrocarbon in the reactor is between 1 and 2 to 1 and the ratio of isobutane to olefin entering the reactor is 3 to 1 to 10 to 1.

Temperatures used in the reaction zone vary from 60 to 100 F. depending upon the temperature of the cooling water. Cooling of the reaction mixture is necessary since the alkylation reaction is exothermic.

The reactor effluent, consisting of saturated light hydrocarbons, alkylate, and dissolved acid, is charged to the fractionation section. The dissolved hydrofluoric acid is recovered as an overhead product in fractionation and is returned to the reaction system.

Some heavy polymers are formed in the alkylation reaction but the catalyst has the advantage that it can be regenerated. The heavy polymer may be removed from hydrofluoric acid by fractionation which continuously returns a purified acid to the reaction zone. There is, therefore, no acid disposal problem.

After removal of the dissolved acid, the hydrocarbon stream is further fractionated to separate the hydrocarbons, an isobutane recycle stream, normal butane, rerun alkylate, and a heavy alkylate which will be a small percentage of the total alkylate produced depending on the end point desired on the rerun alkylate.

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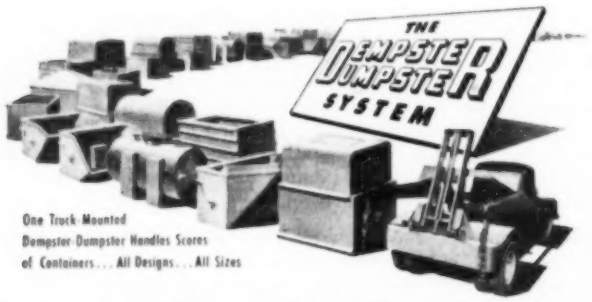

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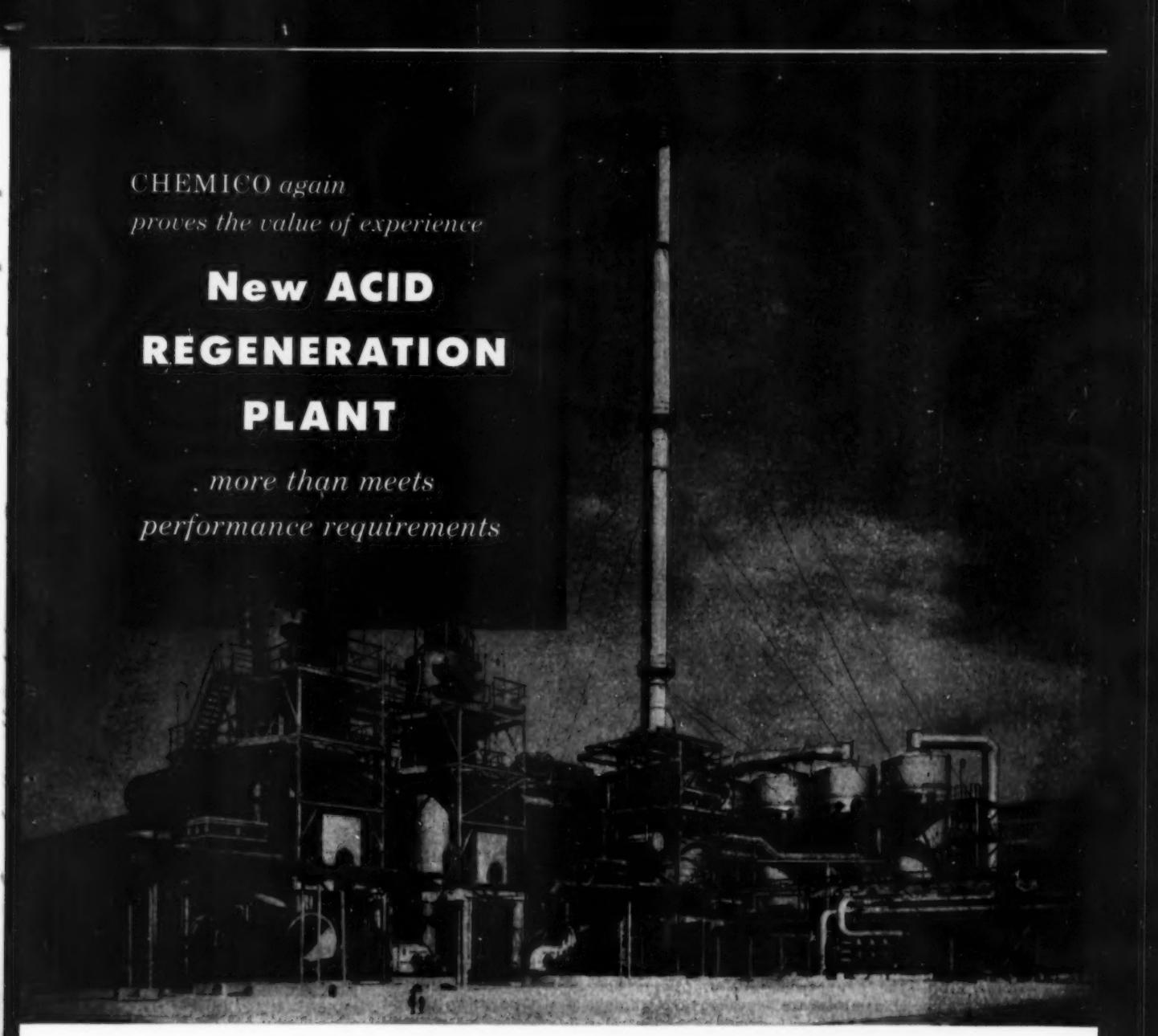

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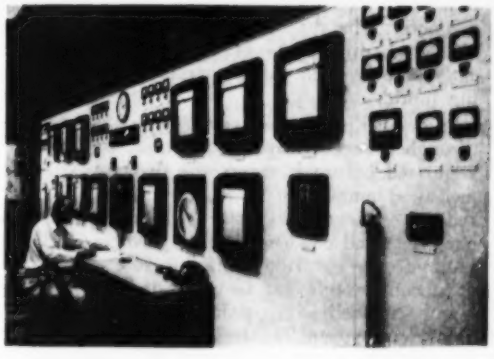

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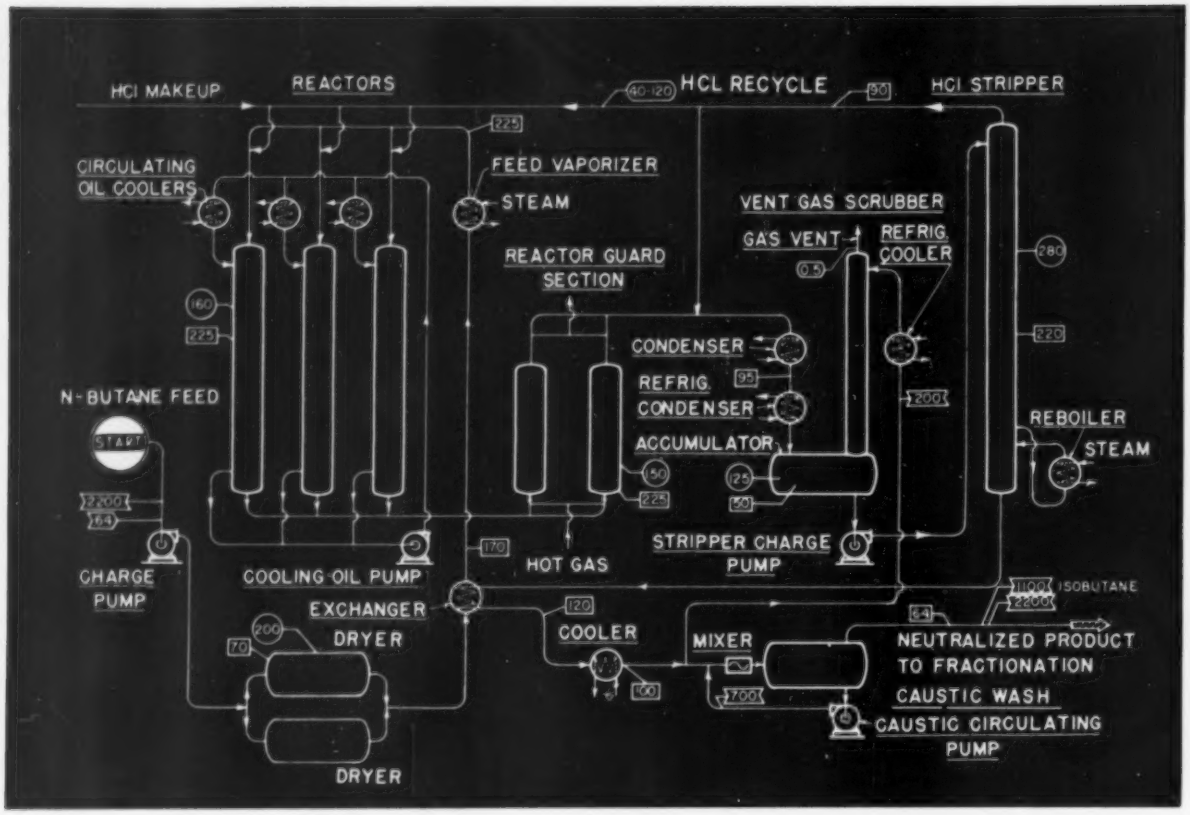


Butane Vapor Phase Isomerization—SHELL DEVELOPMENT COMPANY

Application—The process is applied to the isomerization of butane to isobutane.

Description—The process consists of passing normal butane vapor, at a moderate temperature, through a reactor or bank of reactors packed with a granular catalyst containing aluminum chloride. Dry hydrogen chloride gas is incorporated with the butane vapors to act as a catalyst promoter. The reactors may each consist of a single catalyst bed, or may be of a heat-exchanger type with the catalyst placed in tubes surrounded by circulating cooling liquid.

In typical plants the hydrocarbon charge is first pumped through a regenerative drying unit. It is then completely vaporized before it enters the reactors, together with a measured amount of hydrogen chloride recycle gas. The reactor effluent flows to a receiver through a cooler and a refrigerated condenser which condenses all the butanes, the hydrogen chloride going into solution. A small amount of uncondensable gas is vented from the receiver after being scrubbed with product recycle to recover hydrogen chloride. The condensate is charged to an HCl stripping column which effects substantially complete removal of recycle hydrogen chloride gas. Butanes, essentially free of hydrogen chloride, flow from the base of the column, while vapors, consisting largely of hydrogen chloride, are recycled to the reactors. Traces of hydrogen chloride in the isomerized product are removed by caustic scrubbing. The catalyst is resistant to poison, but it is necessary to reduce the proportion of olefins and pentanes in the charge stock to a low figure, since both of these produce objectionable by-products and tend to shorten the life of the catalyst.

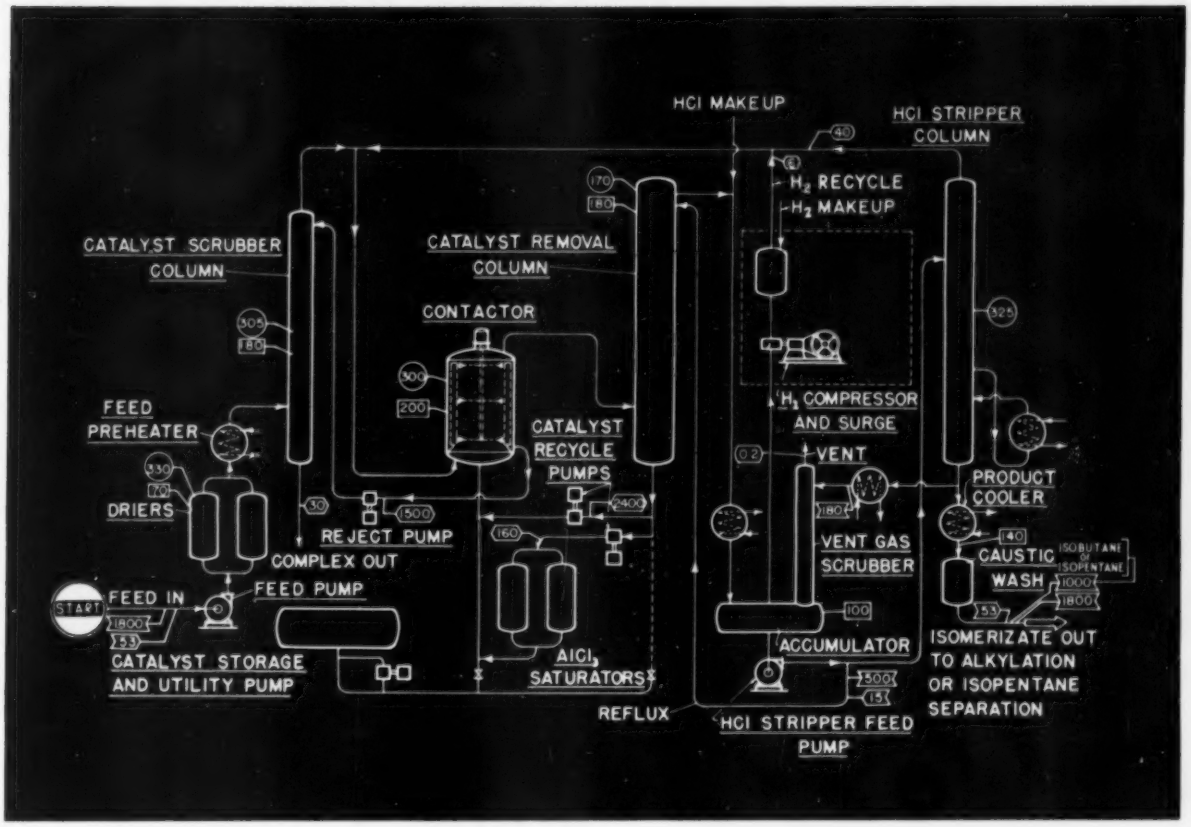
Operating Conditions—The table illustrates typical operating data.

	Plant 1	Plant 2
Normal butane charge to reactor, Bbl./Day	3510	1720
Isobutane in product, volume percent	47.6	42.2
Reactor inlet temperature, °F.	253	213
Reactor pressure, lbs./sq. in. gauge	262	163
Hydrogen chloride in reactor feed, mole percent	16.8	11.6
Catalyst consumption, lb./day	3180	1120
Alumina ($AlCl_3$ absorber) consumption, lb./day	779	684
Hydrogen chloride consumption, lb./day	†	91
Isobutane produced, gal./lb. catalyst	24.0	27.1
On stream time, percent	96.7	91.7
Space velocity in catalyst bed, liq. vol./vol./hr.*	1.01	0.84
Space velocity in $AlCl_3$ absorber, liq. vol./vol./hr.*	1.50	1.83

* Based on plant feed.
† Quantitative figures unavailable.

Commercial Installations—Nine units as follows:

Shell Oil Company, Inc.,	Houston
The Texas Company,	Port Arthur, Texas
The Texas Company,	Lockport, Ill.
Richfield Oil Company,	Watson, Calif.
Tide Water Associated Oil Company,	Avon, Calif.
Union Oil Company,	Wilmington, Calif.
Sinclair Refining Company,	Sinclair, Wyo.
Trinidad Leaseholds, Ltd.,	Trinidad, B. W. I.
Curacaosche Petroleum Ind. Mij.,	Curacao, N. W. I.



Liquid Phase Isomerization—SHELL DEVELOPMENT COMPANY

Application—The process is applied to the isomerization of butane and pentane.

Description—The normal liquid paraffin (butane or pentane) is charged continuously at essentially atmospheric temperature through one of two feed dryers (used alternately and regenerated periodically) through a heater where the temperature is raised to about 130 F., thence through a packed catalyst-scrubber column and into the contactor. A liquid-liquid extraction of a small side-stream of the contactor catalyst with the feed takes place in the scrubber. The valuable active catalyst components pass back to the contactor in solution while the fluid inactive $AlCl_3$-hydrocarbon complex, which forms as a consequence of the small amount of side reactions, runs to the bottom of the column and is periodically drained off.

The contactor is a vertical autoclave equipped with a mixing device to provide intimate contacting of catalyst and hydrocarbon. A relatively short residence time, of the order of 10 to 15 minutes, in the contactor is sufficient to achieve a high conversion: 50 percent or better for butane and 55 to 60 percent for pentane. After phase separation from the catalyst in the baffled upper settling section of the contactor, the isomerizate flows to the catalyst-removal column for separation of dissolved catalyst by a simple fractionation. This recovered catalyst is pumped back to the contactor; the isomerizate is taken overhead, condensed, and pumped to the HCl stripper where the acid gas is removed and recycled to the contactor. The isomerizate, thus essentially freed of HCl, is given a caustic wash and sent to subsequent operations.

When isomerizing n-pentane, the reaction is effected in the presence of a small amount of hydrogen to suppress disproportionation reactions. The bulk of the hydrogen is recycled from the top of the catalyst column accumulator; however, some passes in solution to the HCl stripper and is recycled with the HCl.

The small amount of uncondensable gas that is formed is vented from the accumulator through a scrubber.

Operating Conditions—See Table 1.

Yields—See Tables 2 and 3.

Commercial Installations—Six installations.

TABLE 1—Design Conditions

Process Conditions	Butane	Pentane
$AlCl_3$ content of catalyst, wt. %	9-10	3
Temperature in contactor, °F.	176-194	176-212
HCl content of feed, weight percent	5	5
Average residence in contactor, min.	12 (2.5 LHSV)	12 (2.5 LHSV)
Catalyst to hydrocarbon vol. ratio in contactor	1	1
Operating pressure, contactor, psig	300	300
H_2 partial pressure in contactor	.....	60 psi. minimum
H_2 concentration in feed, mole %	.....	1.3

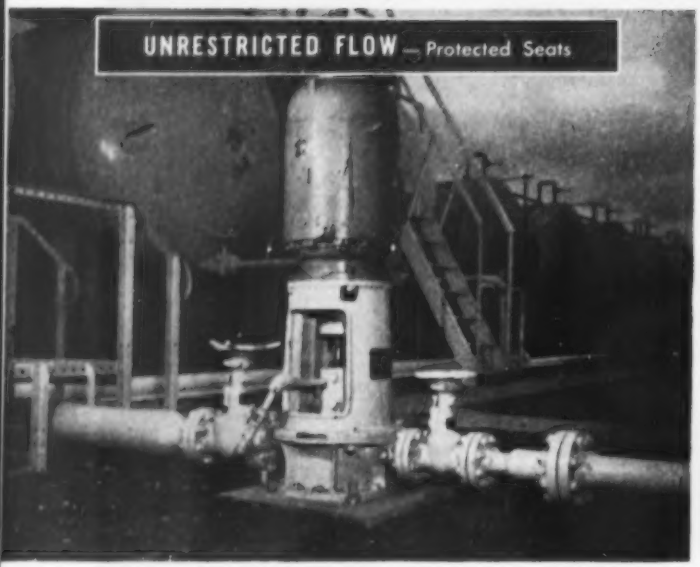
TABLE 2
Average Yield Data from Butane

Component, Volume Percent	Feed Stock	Single Pass Isomerizate
Lower boiling than butanes	0.0	<0.3
Isobutane	4.2	54.5
Normal butane	95.6	43.7
Isopentane	0.2	1.5
Hydrocarbons as $AlCl_3$ complex	....	<0.1
Yield of isoparaffin	....	97

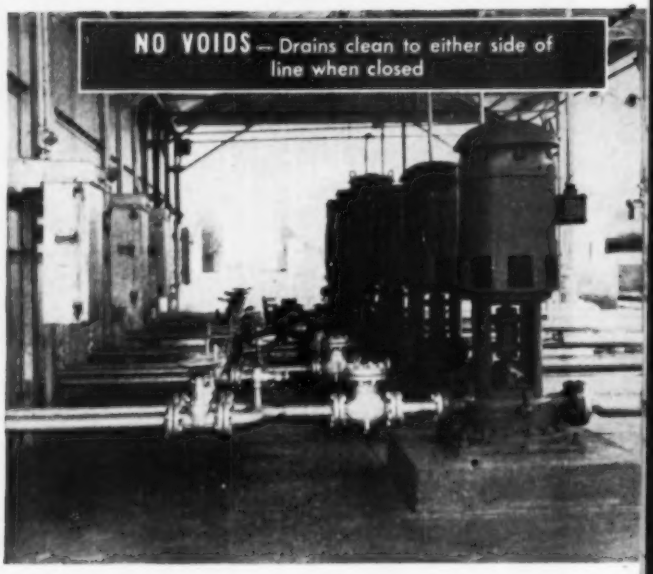
TABLE 3
Average Yield Data from Pentane

Component, Volume Percent	Feed Stocks	Single Pass Isomerizate
Butanes	0.0	0.6
Isopentane	6.1	60.5
Normal pentane	90.7	35.0
Heavier than normal pentane	3.2	3.8
Hydrocarbons as $AlCl_3$ complex	....	<0.1
Yield of isoparaffin	....	97

Look Where ORBIT VALVES .



Centrifugal Pump on Products Line to Surface Storage. Flow characteristics are important. Orbit full opening valves provide straight through flow.



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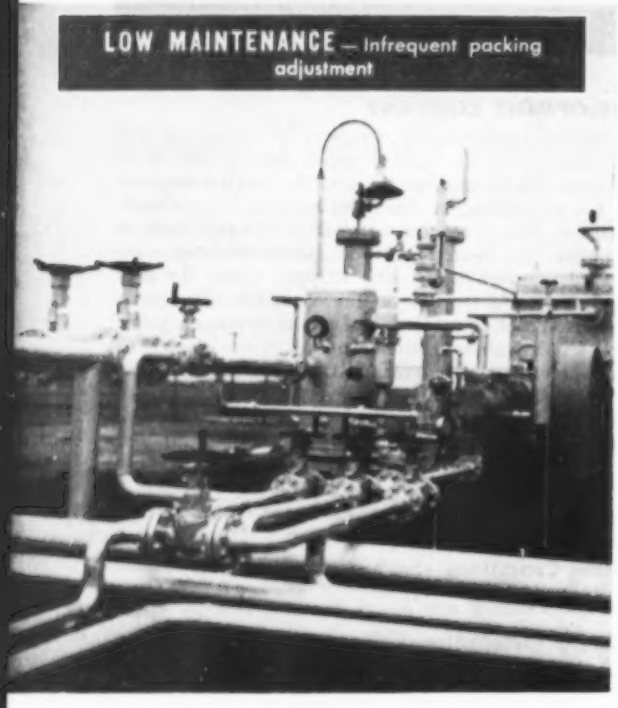

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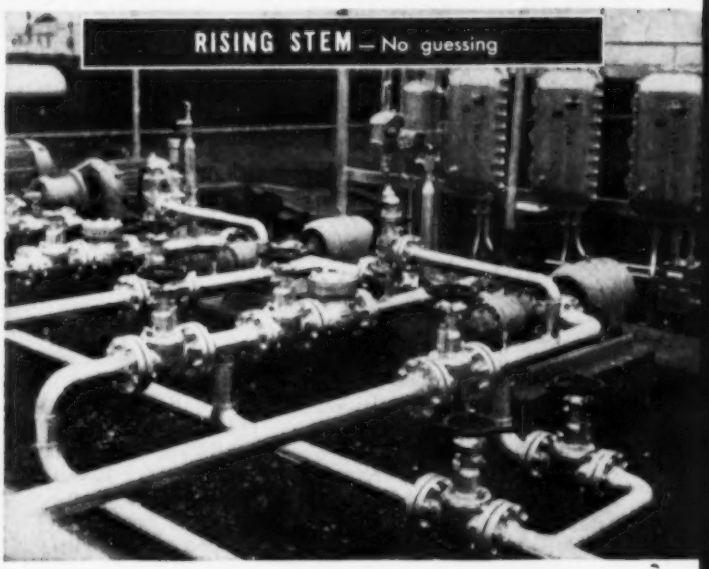

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About ORBIT VALVES

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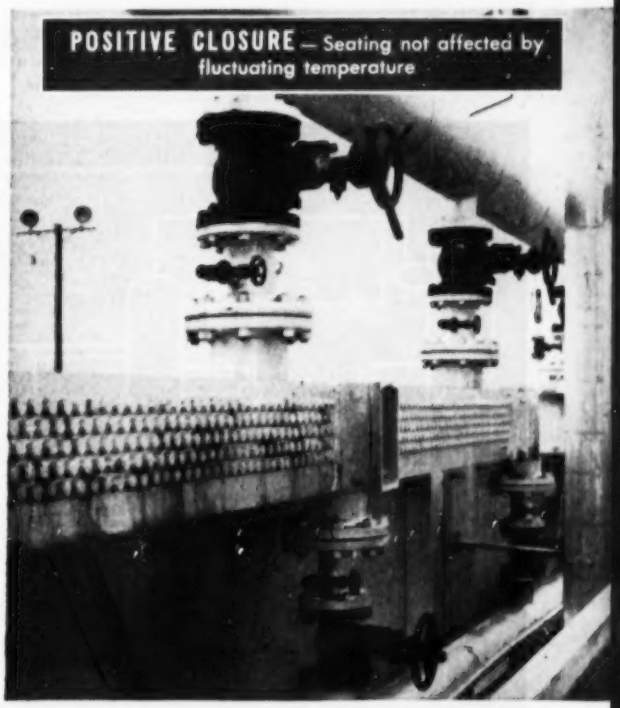

De-Iso Butanizer Overhead Condenser. The Orbit Valve resilient seating principal insures positive closure even though temperature changes may occur.

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Crude Distillation for Maximum Lubes—FOSTER WHEELER CORPORATION

Application—The process is applied to the fractional separation of crude oil while producing a maximum yield of lubricating oil stocks.

Description—Referring to the simplified flow diagram the crude oil enters the unit through the reflux recirculating system (B) and is then split into two streams. One stream picks up further heat through heat exchange with the trade gas oil fraction (G) from the atmospheric tower and this preheated stream then moves on to the electrolytic desalter. The other portion of the stream acquires additional heat through heat exchange in the light vacuum gas oil reflux circulating system (D) and it too enters the electrolytic desalting system.

Leaving the desalter, the preheated crude is further increased in temperature by heat exchange in the reflux recirculating system (E). It then passes directly to the prefractionator where water and light gasoline and noncondensable gas are flashed off. The partially reduced crude is pumped from the prefractionator and this stream is also split into two parts. A small stream passes through the convection section of the vacuum direct-fired heater and re-enters the prefractionator. This is a process means of maintaining a desired temperature in the prefractionator. The major portion of the stream leaving the prefractionator exchanges heat in the recirculating reflux system (C). It then passes through the recirculating reflux system (F) picking up more heat and finally obtains its last preheat by passing through an exchanger through which the hot asphaltic bottoms from the vacuum unit are being pumped.

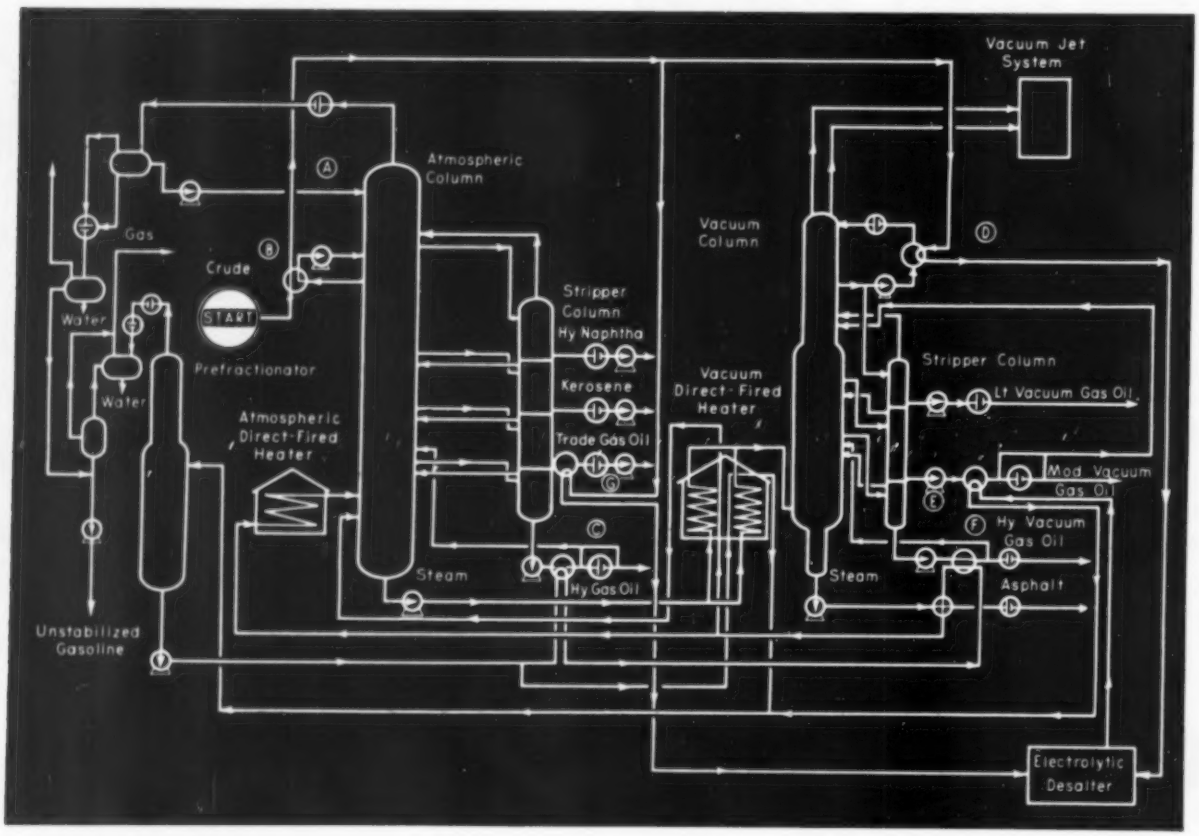
The partially reduced crude, now preheated to a temperature of 420 F., is also split into two streams. One stream enters the convection section of the direct-fired vacuum heater and passes directly to the atmospheric column. The major portion of the stream passes directly to the direct-fired atmospheric heater in which it is raised in temperature for the purpose of vaporizing the products required from the atmospheric fractionating column. The mixture of reduced crude and vaporized lighter products then passes directly to the atmospheric column where the fractionation into the desired products takes place.

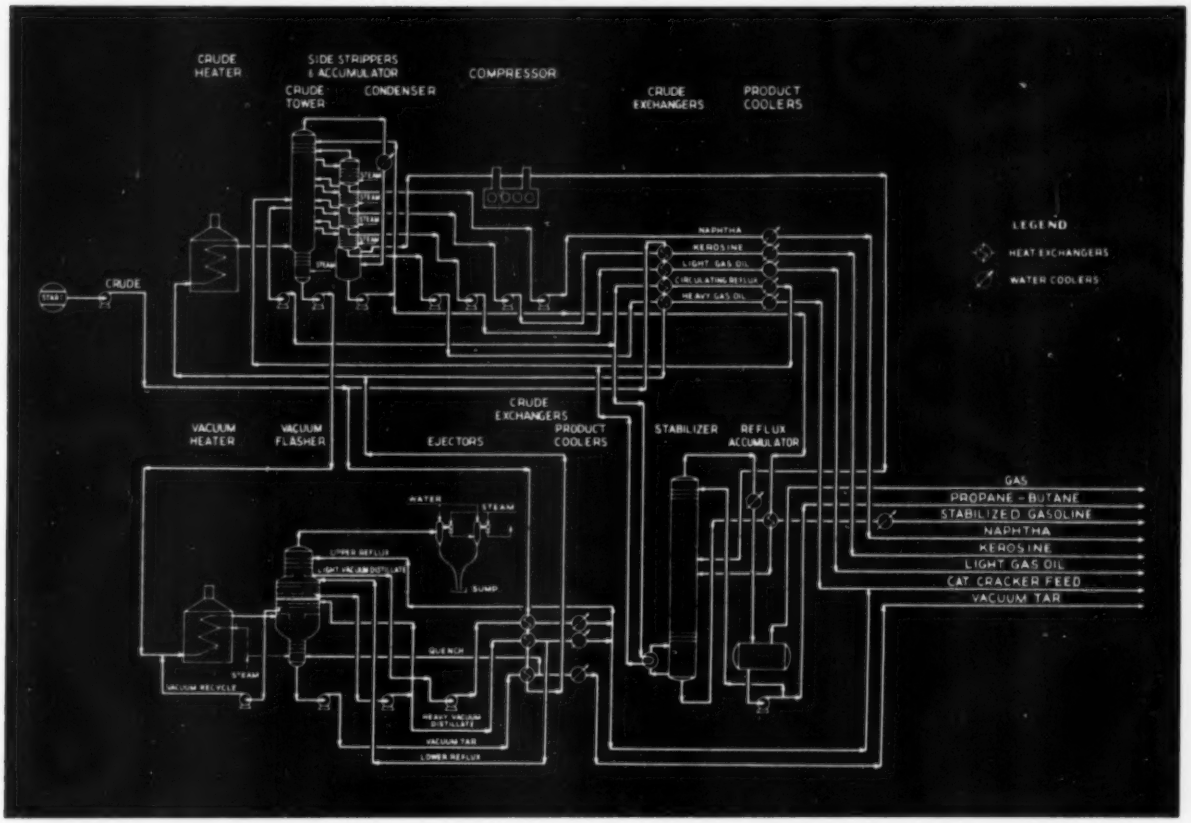
The overhead vapor from the atmospheric column is condensed and enters an accumulating and separating system and finally joins with the condensed vapor which was flashed off in the prefractionator. In this system, gas and liquid are separated and water is drawn off. The condensed petroleum product is pumped away to storage.

Four sidestream products are removed from the atmospheric column and enter the stripping tower where they are flashed to specification quality. The vapor stripped-off by open steam returns to the column. The stripped sidestreams are cooled and pumped to storage.

The reduced crude from the bottom of the atmospheric column is pumped directly to the radiant section of the direct-fired vacuum heater in which it is raised in temperature to effect vaporization of all but an asphaltic residue. This mixture of vapor and asphalt then passes into the vacuum fractionating column for the purpose of separating the mixture into desired intermediate products.

Three lubricating distillate sidestreams and a residue are drawn from the vacuum column and are pumped through coolers to storage for subsequent processing. The asphalt residue is pumped from the bottom of the vacuum fractionating column.





Crude Distillation for Maximum Cracking Feed—

STONE & WEBSTER ENGINEERING CORPORATION—BADGER PROCESS DIVISION

Application—The process provides a means of obtaining maximum catalytic cracker feed by distillation of crude oil.

Products—The products shown are typical of a combination atmospheric and vacuum distillation unit. Catalytic cracker feed consists of atmospheric heavy gas oil augmented by light and heavy vacuum distillates.

Description—Crude oil is preheated by exchange with product and reflux streams before passing through a fired heater to the crude tower. The exchanger arrangement is selected on the basis of distillate draw-off temperatures and fuel value to give maximum economical heat recovery.

Initial fractionation of the crude oil takes place at essentially atomspheric pressure to produce the overhead and the four side streams shown. The overhead passes to a condenser and the net light gasoline product charged to a stabilizer for vapor pressure control. Uncondensed gas is compressed and flows to the stabilizer for recovery of propylene and heavier fractions. Alternatively, the stabilizer might be integrated with the catalytic cracker gas recovery unit.

In order to obtain maximum yield of gas oil suitable for catalytic cracker feed, the bottoms from the crude tower is further heated and vaporized in the vacuum flasher. Steam is used to assist vaporization and avoid excessive temperatures which would cause undersirable cracking of the residue. The selection of the optimum operating pressure in the vacuum flasher is influenced by a number of factors, including maximum permissible flash temperature, steam to hydrocarbon ratio and temperature of cooling water for the vacuum condensers or barometrics.

Vacuum distillate is condensed within the tower and withdrawn as two side streams to improve the heat recovery. Both atmospheric and vacuum towers are equipped with circulating reflux systems for heat removal. This arrangement reduces top reflux and tower size, and provides high level heat for crude exchange and reboiler service.

The production of a catalytic cracker feed with minimum carbon residue and metal contaminants is of great importance. Carbon residue can cause excessive coke formation while metal contaminants seriously affect catalyst selectivity and product yield distribution. Provisions for minimizing entrainment in the vacuum tower are therefore imperative. In the unit shown, entrainment is minimized by the use of wash trays and wire mesh located above a properly designed vaporizer. Wire mesh may also be used in the atmospheric tower to improve heavy gas oil quality.

Liquid from the bottom wash tray is pumped back into the feed entering the heater. A continuous flow of oil over the trays below the heavy vacuum distillate is thereby assured, without diluting the vacuum residue.

Vacuum tar is steam stripped and pumped through heat exchangers to storage. This product may be cut-back with a catalytic cycle stock or other low quality distillate for use as refinery fuel. A portion of the cooled tar is returned to the base of the tower to reduce the temperature and prevent coking of the residue.

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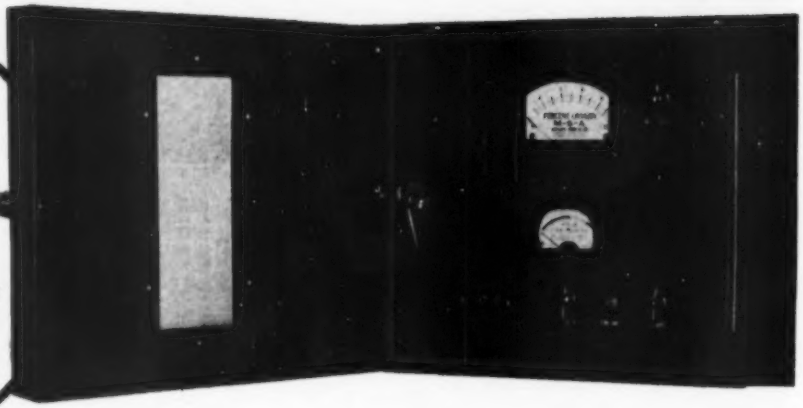

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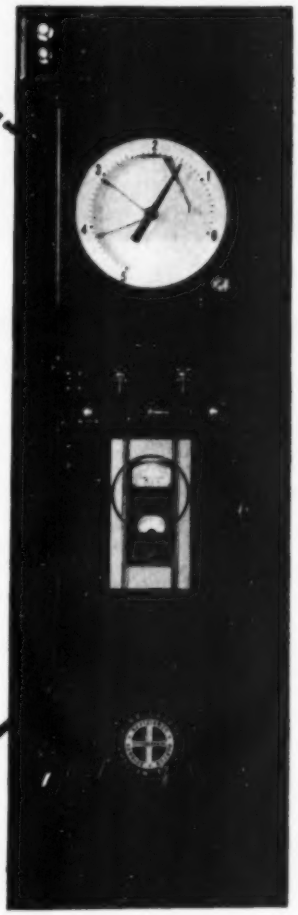
This instrument can be supplied complete with steel panel and base, with all accessories assembled, wired and permanently mounted on the panel. An electronic recording potentiometer may be mounted in the panel if desired. Recorders can be supplied with either strip or round charts.



APPLICATIONS:

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- FLUID CATALYTIC CRACKING
  0 to 1% Oxygen in Regenerator Flue Gases
- INERT GAS CONTROL
  0 to 1% Oxygen in Inert Gases
- COMBUSTION CONTROL
  0 to 1% Oxygen in Flue Gases

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REFINERY PROCESS NEWS

PUBLISHED BY REFINERY PROCESS DIVISION, THE M. W. KELLOGG COMPANY AUG.-SEPT. 1954

Combination Processing Effects Big Savings in Direct Operating Costs

While first investment costs are probably as closely scrutinized as any other figures in planning a new oil refinery, the combination design offers several additional advantages over conventional unit-by-unit processing. One of the most important is found in direct operating costs. Substantial savings are possible in such items as labor, fuel, power, steam, water, and maintenance.

Although there are savings in maintenance charges and utilities —particularly through the conservation of heat due to the virtual elimination of intermediate storage —the largest reduction in direct operating costs for combination units is derived from smaller labor requirements.

Labor Requirements Reduced by More Than 20 Per Cent

Total operating personnel needs may be slashed by about 30% while total refinery personnel which includes clerical, maintenance and supervisory staffs, may be cut more than 20%.

For example, a 10,000 BPD conventional plant requires an estimated payroll of 90 operating men in comparison with 63 for a combination refinery. As far as total personnel are concerned, the comparison shows 206 versus 157. Studies of 20,000 BPD and 40,000 BPD capacity installations indicate similar low labor requirements for combination plants.

In addition to the savings already mentioned, combination refining has a further advantage in improving yields by reducing evaporation and other losses. About a 1% increase in gasoline yield can be expected in a 10,000 BPD combination unit, or about 4,200 gallons daily.

Together with savings in first costs, operating savings can increase the percentage return on a combination refinery up to one and one-half to two times that of a plant comprising individual units.

20 to 25% Investment Savings Spur Use of Combination Processing

A total of six combination refinery projects underway by Kellogg —all but one of them completely new refineries—spotlight the fact that the combination processing principle is an important answer to the petroleum industry's increasingly competitive market picture. More than sufficient incentive for the trend has been the possibility of slashing as much as 25% from the total cost of a new refinery by combining the various process steps into a single, centrally controlled operation.

Combination processing is, of course, not a new idea. A fundamental chemical engineering technique, it was first applied to refining in the early thirties when Kellogg engineered several prototypes of modern integrated plants. After World War II, the present trend began in earnest once stable competitive conditions returned to the market and processing economics again became primary considerations.

The postwar building program saw numerous combination thermal cracking refineries in South America, Europe and the Middle East. In the U. S. and Canada, the trend has continued with new combination refineries as well as expansion and modernization programs in which existing units have been integrated with new facilities. And in many programs, the original concept was extended to catalytic processes including cracking, alkylation, polymerization, and reforming.

Major Savings Achieved in Two Principal Areas

In designing a plant as a combination operation (as opposed to the conventional design wherein a series of individual, independently controlled process units are each complete with intermediate storage) investment costs are cut in two important categories. Perhaps the most obvious is in the elimination of intermediate storage and other off-site facilities. Economic studies, later proved by experience, have shown that for a combination plant, cost of off-site facilities can be reduced as much as 40%.

Other savings stem from economies in process equipment. By skillful integration, the same fur-

(Continued on reverse side)

REFINERY PROCESS NEWS

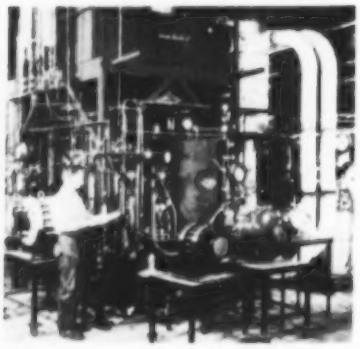
CONTINUED FROM PRECEDING PAGE

(Continued from previous page)

20 to 25% Savings...

naces can be made to serve more than one purpose; towers can be made to handle streams from more than one operation; the number of pumps can be radically reduced since intermediate products are not stored between processing steps; and, for the same reason, heat is retained in the stream from one process step to the next so that the number of heat exchangers is reduced throughout the refinery. Final savings in process equipment alone can be anywhere from 5% to 15%.

The overall effect of these savings adds up to the possibility of erecting a complete new refinery—in combination—for around 20% to 25% less than the cost of building comparable equipment incorporating separate process units.



KELLOGG PILOTS SUPPLY DESIGN DATA ... this unit is utilized to study the combination operation of a catalytic reformer with a desulfurization plant.

For further information, technical data, etc., on any refining process, write

REFINERY PROCESS DIVISION

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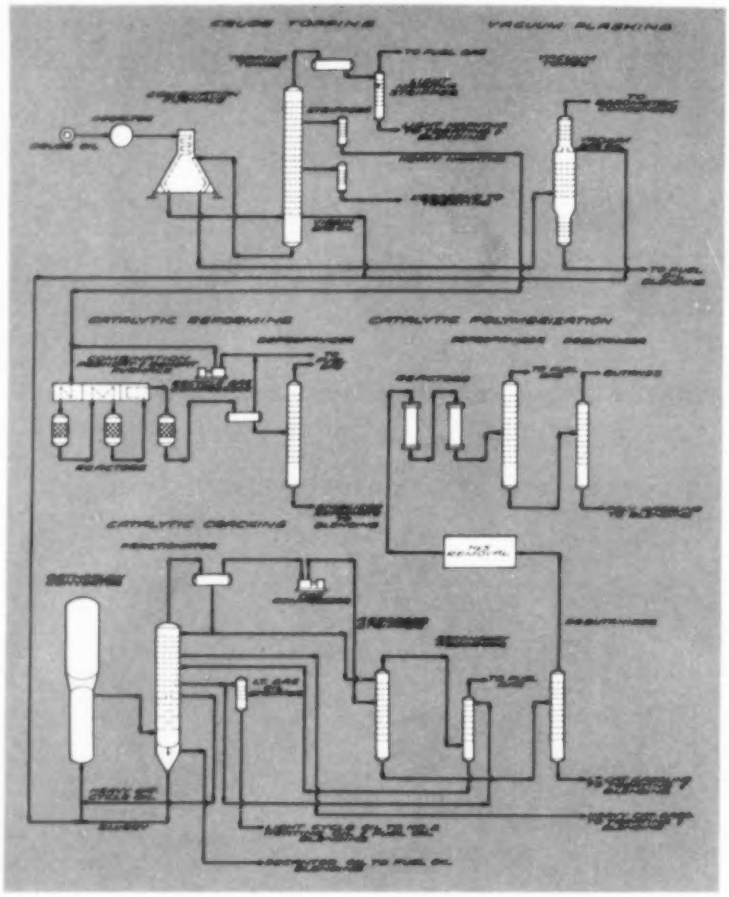

Flow Chart Highlights Savings...

The variety of processing sequences that may be operated in combination is limited only by the number of processes available or desired. The accompanying simplified flow sheet shows one type of combination refinery. It includes topping, catalytic reforming, vacuum flashing, Orthoflow fluid catalytic cracking, gas recovery and catalytic polymerization. The flow of oil is clearly indicated.

As can be noted, combination has effected a number of economies in investment costs. One furnace handles the heating requirements of the topping unit and vacuum flasher instead of the conventional two. A combination furnace is also employed in the reforming step.

Further savings are obtained in the cat cracking step. No charge furnace is required because the gas oil from both the topper and vacuum flasher is at a high enough temperature to be fed directly to the unit.

These are some of the more obvious investment savings reflected in the flow chart. Others include elimination of intermediate storage, reduction in heat transfer equipment, lower pumping requirements, and elimination of control room duplication.

In some types of combination plants, one tower may serve the fractionating requirements of two or three different processes. Another instance of a unique processing advantage is that one process can be made to eliminate a component which has a deleterious effect on a subsequent process: e.g., combination catalytic polymerization and alkylation wherein the cat poly process reduces the amount of butene-1 in the C_4 cut, a component which otherwise lowers the octane of the alkylate product, although it is the best butene for polymerization. These are but a few of the many advantages which can accrue from combination design.

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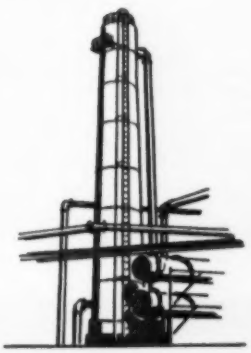

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Duo-Sol—MILWHITE COMPANY, INC.

Application—The process is applied for the extraction of high viscosity index, light color, low carbon residue lubricants from any residual or distillate base stock.

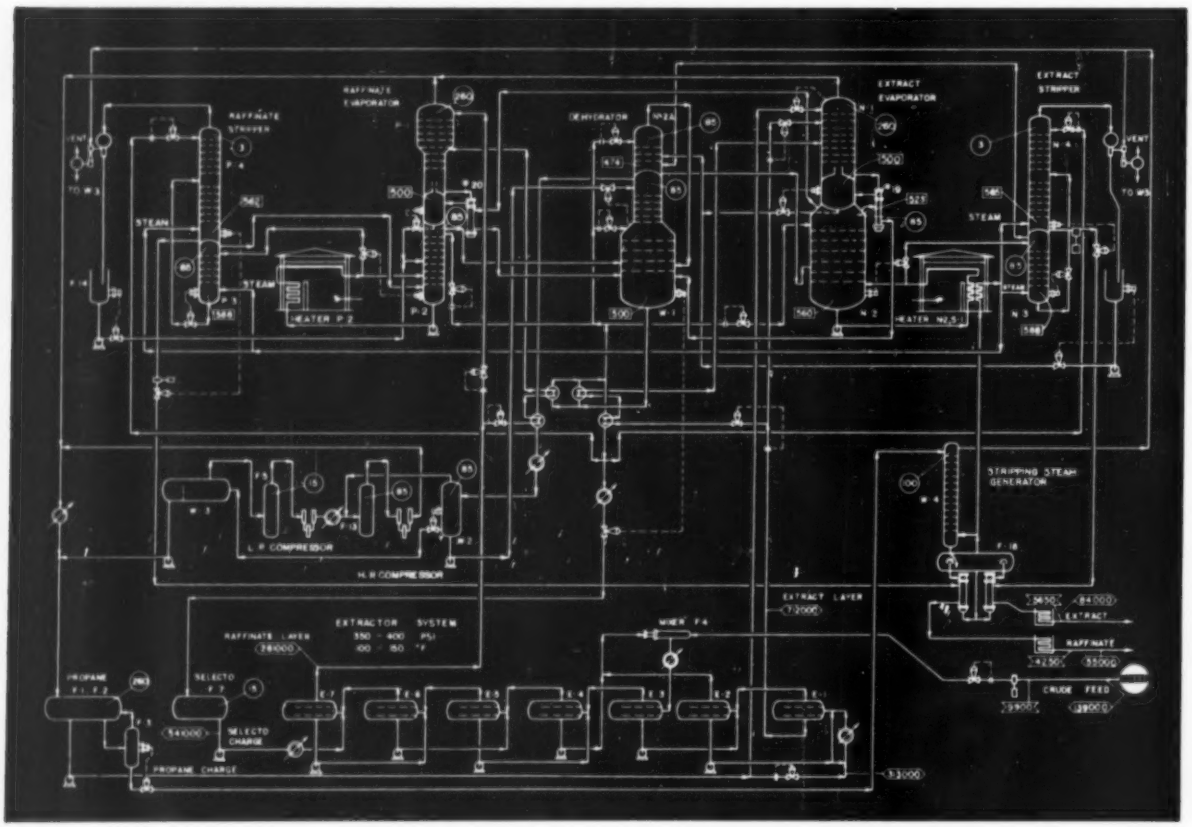
Description—The Duo-Sol process of solvent extraction is exclusive in its application of two solvents acting simultaneously and countercurrently on a charge stock introduced in the center of the extraction system. For maximum extraction efficiency, the countercurrent extraction is carried on in seven separate stages, identified as E-1 to E-7 on the flow diagram. The solvents employed, both of which are frequently refinery by-products, are propane which has affinity for raffinate and Selecto (a blend of cresol and phenol) which preferentially dissolves asphalts and undesirable aromatics, naphthenes and color bodies. In operation, the propane is charged into the E-1 end of the extraction system and Selecto into the E-7 end. In each extractor, the propane-raffinate leaves the top of the extractor vessel and passes to the next higher numbered stage, while the Selecto-extract is withdrawn from the bottom of each stage and pumped to the next lower numbered stage. Charge stock is generally admitted into E-3, together with raffinate phase from E-2 and extract phase from E-4. Raffinate progressing from E-3 to E-7 is treated in each stage with less diluted, more effective Selecto and extract from E-3 is stripped of all desirable constituents by propane in stages E-2 and E-1.

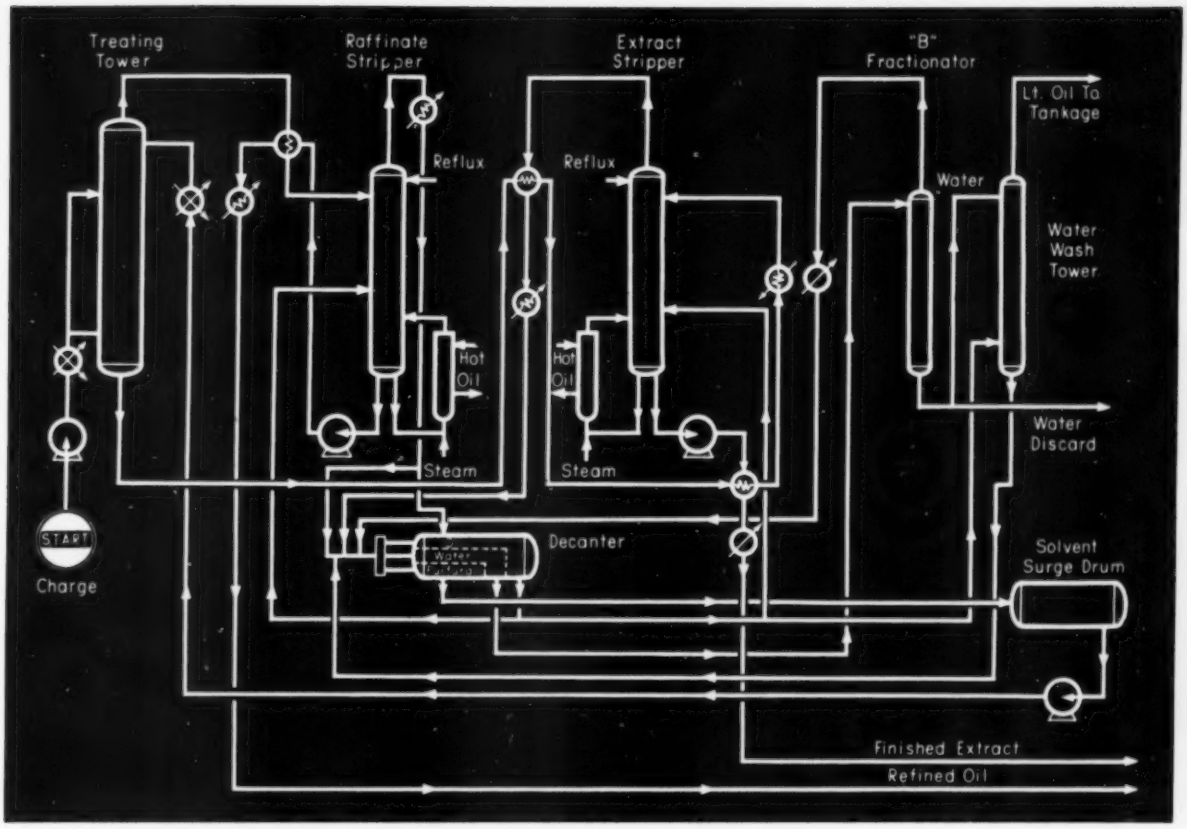
The solvents propane and Selecto are removed from the extract and raffinate layers by distillation in raffinate and extract evaporators P-1—P-2 and N-1—N-2, which consist of a upper section for higher pressure propane evaporation, and a lower section of the same vessel for evaporation of Selecto at low pressure. The final traces of Selecto are removed by a steam stripping in towers P-3, P-4, N-3, and N-4. This steam is removed from the distillation system as a constant boiling mixture at the top of tower W-1. After condensation and decantation the water containing Selecto is pumped to the propane charge tank to reduce the Selecto content to approximately two percent; from here it flows to tower W-4. Steam overhead of W-4 containing Selecto is employed for vacuum jets, while the steam obtained from the steam drum (F-19), essentially Selecto-free, is employed after superheating for the final steam stripping in the vacuum towers P-4 and N-4.

Yields—Typical extraction results are tabulated below:

	East Texas-Louisiana Residuum	San Joaquin Long Residuum	East Texas Distillate	Van Zandt Long Residuum	Iraq Long Residuum
Charge Stock:					
Gr. (ASTM)	15.2	14.9	26.2	17.4	14.8
Vis. @ 210° F. (SUS)	760	257	47.4	179	194
V.G.C.	.876	.893	.839	.879	.899
Flash (°F.)	595	470	420	435	420
Raffinate—(Dewaxed):					
Gr. (ASTM)	26.5	29.3	29.9	27.5	27.6
Vis. at 210° F. (SUS)	143.3	61.0	48.0	64.4	54.2
V.G.C.	.809	.808	.811	.818	.822
V.I.	95	94	95	98	100
Pour	0	0	0	0	0
Color (ASTM)	8	4½	2½	5	3½
Conradson Carbon	.4	.1	.02	.25	.25
Duo-Sol Yield:					
Percent by Volume	43.6	34.7	73.0	60.9	55.0
Extract:					
Specific Gravity	1.026	1.0177	1.000	1.053	1.073

Commercial Installations—Nineteen.





Furfural Extraction of Gas Oils—TEXACO DEVELOPMENT CORPORATION

Application—The process is employed for the solvent extraction of diesel fuel oils, burning oils and cracking stocks to remove materials having low cetane number as well as such undersirable materials as unstable, acidic, sulfur, organo-metallic and nitrogen compounds.

Product—The resultant treated oils have a higher cetane number and show a marked degree of improvement in engine cleanliness, improved burning qualities and greatly reduced sulfur, nitrogen and metals content.

Description—This process for the extraction of gas oils is an outgrowth of the Furfural refining process which is widely used for refining lubricating oils.

The extraction temperatures and furfural treating ratios for gas oils are generally lower than when refining lubricating oil stocks. The principal difference between these two processes, however, lies in the equipment for the recovery of furfural from the raffinate and extract solutions.

Following an azeotropic distillation, solvent-free raffinate and extract streams are taken from the base of the respective strippers, while the overhead vapors from these columns comprising an azeotropic mixture of oil, water and furfural are condensed and conducted to a decanter. Three liquid phases form in this decanting type of accumulator and all three of the components are present in each phase. The heaviest phase is predominantly furfural which is returned to the solvent circulating system. The intermediate phase is predominantly water which is charged to the water removal equipment from which solvent-free water is withdrawn. The overhead vapors are returned to the system for further separation and recovery of the oil and furfural. The lightest or oil-rich phase is pumped to a tower in which the furfural is extracted from the oil with water. The percentage of light oil to be recovered in this way is dependent upon the initial boiling point of the gas oil charging stock, varying from a negligible percentage for a stock with an initial boiling point of 500 F. or higher to about 3 percent when processing a stock having an initial boiling point as low as 420 F.

Compensation can readily be made to permit the use of furfural containing a small percentage of oil and water.

This process is characterized by low solvent requirements which range from 25 percent of the charge oil when extracting a cycle gas oil stock for re-charging to a catalytic cracking unit to about 40 percent for a catalytic gas oil stock extracted for the production of high quality diesel fuel or furnace oils and to about 80 percent when processing virgin gas oil stocks for the production of fuels, burning oils or cracking stocks.

Yields—The yield of product raffinate is dependent upon the nature of the charge stock and the degree of quality improvement desired. For example, when extracting a virgin gas oil derived from West Texas crude to a raffinate yield of 82 percent, the sulfur content was reduced from 1.12 to 0.49 percent, while the cetane number was increased from 53.2 to 62.9. Similarly, in the extraction of a catalytic cycle gas oil from Middle East crude oil, the sulfur content was reduced from 1.39 to 0.39 percent and the cetane number increased from 44.8 to 62.5 with a raffinate yield of 78.9 percent.

Commercial Installations—Five commercial units have been installed for the furfural extraction of gas oils.

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CASE HISTORY No. 1...

One refiner was operating a 7.5' vacuum tower which was limiting capacity and yields due to the pressure drop of existing bubble trays. Capacity desired was:

Vapor....24,600 #/hr of 0.0137 #/cf density
Liquid.....36,400 #/hr of 58.3 #/cf density

This refiner replaced the bubble trays with "Benturi" Kaskade trays on the same supports, and is now obtaining a pressure drop of less than 1.0 mm hg pressure drop per tray.

CASE HISTORY No. 2...

An engineering firm recognized a pressure drop problem with a process duty equivalent to:

Vapor.....35,500 #/hr of 0.26 #/cf density
Liquid.....965,000 #/hr of 62.4 #/cf density

Yet, multi-pass "Benturi" Kaskade trays in a 7.5' diameter column gave them less than 2.0 mm pressure drop per tray.

Whether your problem is extraordinary or routine, the design flexibility "Benturi" Kaskade tray is probably your answer to greater capacities and higher efficiencies. Wire, write or phone us on its application to your fractionating problem, there's no obligation.

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BENEFIT No. 1 **Increase Yields**

Because of the extremely reactive nature of SULFAN, higher molecular weight compounds can be sulfonated to produce desirable oil soluble sulfonates. Treatment with Sulfuric Acid or 20% Oleum leaves these compounds unreacted.

BENEFIT No. 2 **Eliminate Waste Acid Problem**

Since water is not formed when SULFAN is used for sulfonation, the waste acid problem inherent in using Sulfuric Acid or Oleum is eliminated.

BENEFIT No. 3 **Improve Sulfonation Efficiency**

SULFAN has 99.5% SO_3 available for sulfonation reactions; thus, for many applications SULFAN offers nine times as much usable SO_3 as 100% Sulfuric Acid and over three times as much as 20% Oleum. This can mean a considerable saving in sulfonation costs.

BENEFIT No. 4 **Step Up Processing Efficiency**

The absence of waste acid when using SULFAN permits larger batch sizes or more rapid through-put in a sulfonation process. This means that by using SULFAN, batch size or through-put can be doubled or tripled without increasing the size of the equipment.

Tank Car Quantities

A laboratory development just a few short years ago, SULFAN today is a commercial chemical of ever-growing importance. This new processing tool is now being regularly shipped to many users in tank car quantities. For technical data on SULFAN, experimental quantities, or other assistance, contact any General Chemical office listed below.

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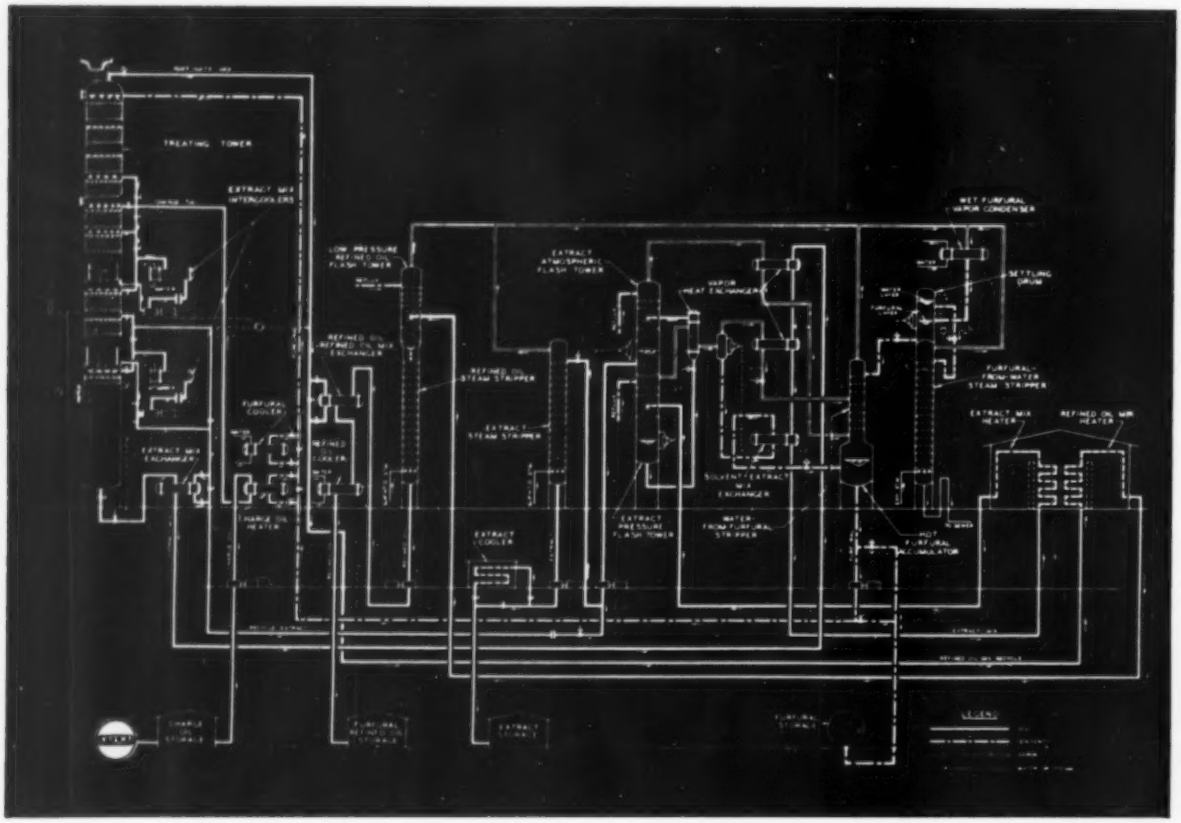


Furfural Refining—TEXACO DEVELOPMENT CORPORATION

Application—The process is employed to extract undesirable components from petroleum lubricating oil stocks and gas oils in order to produce oils of high quality.

Product—The raffinate or refined oil product has greatly improved temperature viscosity characteristics and contains all the desirable lubricating oil components present in the charge stock.

Description—In operation, the untreated oil is introduced into a continuous counter-current extractor at some midpoint and at a predetermined temperature. The temperature of the furfural which enters near the top of the extractor depends largely upon the miscibility relationship between the furfural and the oil being refined. A substantial temperature gradient is maintained between the top and bottom of the tower by indirect, external water coolers. Extraction generally is accomplished by passing the furfural in dispersed phase downward over raschig ring nests through the prevailing oil phase.

The extraction efficiency can be maintained at a high level by the controlled recirculation of the material extracted. The recirculated extract serves to enrich the furfural phase with the more soluble material and thus to displace from solution the last remaining traces of cycle oil which joins the rising oil phase being refined.

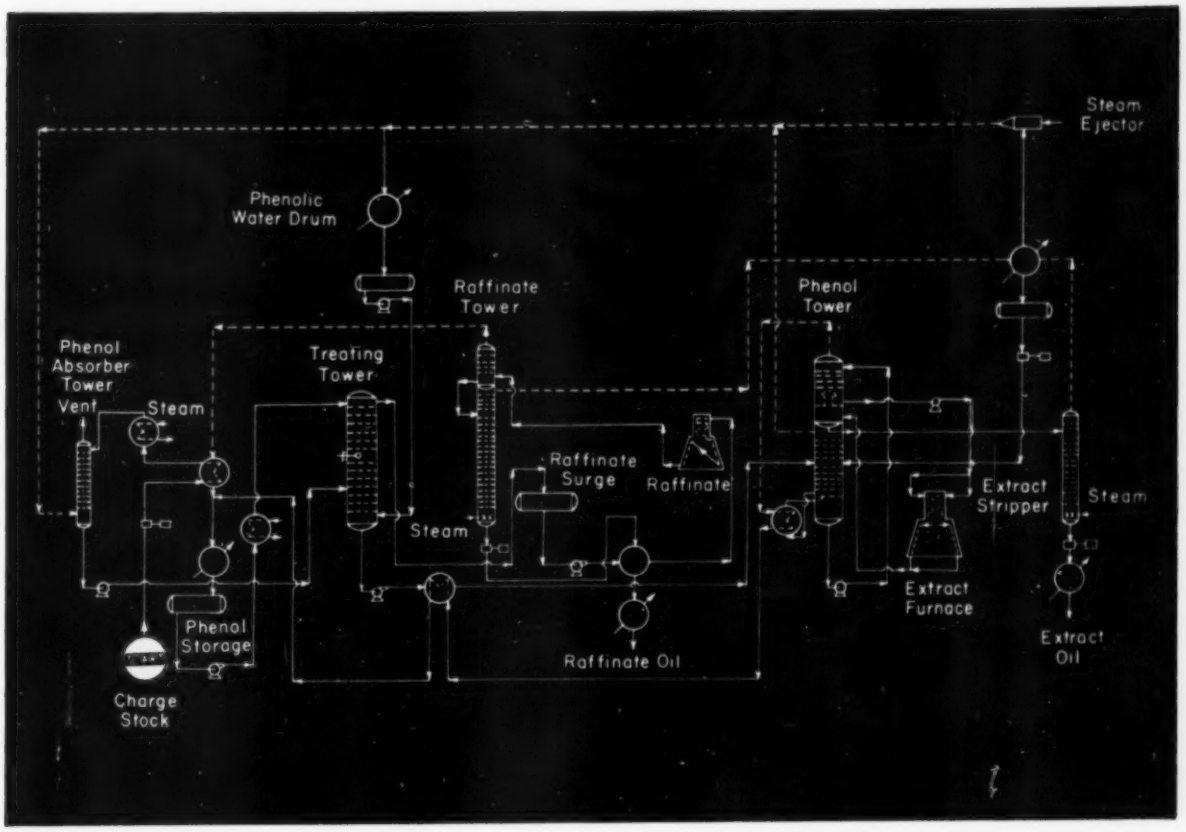
The furfural refining unit represented in the accompanying flow diagram comprises an extraction or treating section, sections for the recovery of furfural from the refined oil and extract solutions respectively, water removal facilities, process surge tanks and pumping equipment. Because of its stability over a wide range of operating conditions, furfural lends itself to a variety of methods of recovery.

Furfural has a high solvent power for those components of petroleum which are relatively unstable to oxygen as well as other undesirable materials including color bodies, resins, carbon-forming constituents and sulfur compounds.

Yields—The operating conditions employed and the yields of raffinate obtained depend upon the nature of the charge stock and the degree of refining desired. Data of just a few of the many stocks typical of those processed for lubricating oil production are shown below:

Commercial Installations—Forty-four units. In addition, 5 units are under construction or being designed.

Crude Source	East Texas	East Texas	Oklahoma City
Grade	Light Neutral Distillate	Deasphalted Bright Stock Residuum	Intermediate Viscosity Distillate
W—			
Physical Characteristics Charge Oil:			
Gravity, °API	28.3	23.1	25.4
Viscosity, SSU/210 F	41.0	132.6	69.3
Carbon Residue, percent	0.07	1.40	0.52
Raffinate:			
Gravity, °API	32.5	29.6	30.9
Viscosity, SSU/210 F	40.4	102.3	58.4
Carbon Residue, percent	0.01	0.20	0.03
Yield, percent by volume	85.0%	60.0%	76.9%
Dewaxed Raffinate:			
Gravity, °API	29.8	27.2	29.7
Viscosity, SSU/210 F	43.0	140.6	63.2
Viscosity Index	96.0	94.1	96.0
Pour Point, °F	20	0	0
Extract Gravity, °API:	8.0	13.9	9.5



Phenol Extraction— THE M. W. KELLOGG COMPANY

Application—The process utilizes liquid-liquid extraction for improving the viscosity index, color and oxidation resistance, and for reducing the carbon and sludge-forming tendencies of lubricating oils.

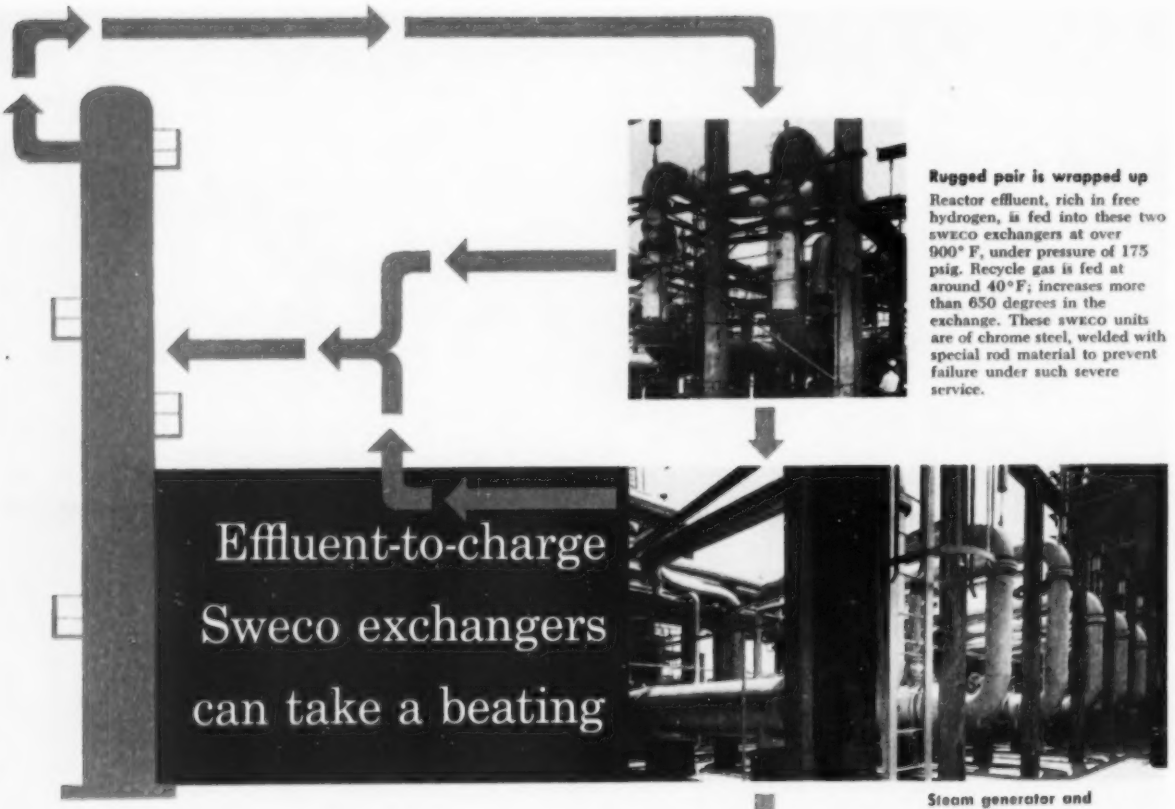
Description—In this process the feed stock flows first through a phenol absorber tower to recover the small amount of phenol from steam being discharged from the plant. The feed is pumped from the absorber to the treating tower. Phenol enters at the top tray. Raffinate phase leaves the tower top to a surge drum and, after heating, is flashed into the evaporator section of the raffinate tower. Phenol vapor from this section flows to a condenser and storage tank. The raffinate oil flows down to a section in which it is steam-stripped free of solvent and withdrawn as bottoms to storage. Steam and solvent vapors flow from the stripping section to vacuum equipment.

The extract phase from the bottom of the treating tower is pumped through heat exchange to enter a drying tower, in which all water is removed as a phenol-water azeotrope. This vapor is condensed and enters the phenolic-water drum. Dry extract solution is pumped from the bottom of the phenol tower to a top evaporator section in which a portion of the phenol is flashed. The remaining extract solution is pumped from the evaporator section through a furnace coil reboiler. Extract oil flows from the evaporator section to a steam stripper in which the last traces of solvent are removed and then to storage.

Yields—The accompanying table illustrates typical yields and product inspection for several stocks:

	Deasphalted East Texas Residue	West Edmond SAE 40 Stock	Deasphalted Van Zandt Residue
Solvent/Oil Ratio Volume	3.0	2.13	3.48
Treating Temperature—F	245	201	200
Raffinate Yield—Volume Percent	64.5	88.2	59.3
Inspections-Untreated Oil:			
Gravity—°API	23.0	28.3	21.2
SSU Viscosity @ 210 F	159.0	77.4	180.1
Color ASTM	5	3	7
Carbon Residue, Conradson, Weight Percent	1.6	0.16	2.58
Dewaxed (Zero Pour) Viscosity Index	59	81	.....
Raffinate Inspections:			
Gravity—°API	29.0	30.2	27.3
SSU Viscosity @ 210 F	110.7	72.3	136.6
Color ASTM	4½	2—	6
Carbon Residue, Conradson, Weight Percent	0.26	0.04	.....
Dewaxed (Zero Pour) Viscosity Index	94	93	101.4

Commercial Installations—There are a total of 23 foreign and domestic units in operation or under construction.



Effluent-to-charge Sweco exchangers can take a beating

Rugged pair is wrapped up

Reactor effluent, rich in free hydrogen, is fed into these two SWECO exchangers at over 900° F, under pressure of 175 psig. Recycle gas is fed at around 40°F; increases more than 650 degrees in the exchange. These SWECO units are of chrome steel, welded with special rod material to prevent failure under such severe service.

Steam generator and Naphtha feed

Steam is generated in two of these SWECO exchangers; in the other four, the naphtha charge to the reactor picks up more than 400 degrees of heat from the effluent.

Sweco condensers finish the job

Final stage in the heat-transfer is accomplished in this bank of four SWECO condensing units. (The effluent loses a total of nearly 800 degrees in passing through the SWECO exchangers in these illustrations.)

It's a tough assignment for a heat exchanger to transfer nearly 225,000,000 BTU over a temperature range of 800°. A SWECO exchanger train, consisting of 12 shells, is doing it in the new Thermofor Catalytic Reformer (TCR) at General Petroleum Corporation's Torrance refinery.

To withstand the wide variation in temperatures in the first stage of heat transfer, SWECO engineered and fabricated exchangers of special high-temperature chrome steel . . . *using welding rod producing metal of identical analysis to the parent metal.* This required precise pre-heat and post-heat treatment of the entire unit during the welding operation.

Fine shop equipment—years of experience in fabricating steel and special alloys—personal follow-through to meet customers' exact requirements and time schedules—all combine to make SWECO a dependable source for engineering and manufacturing process equipment, *no matter how tough the assignment.*

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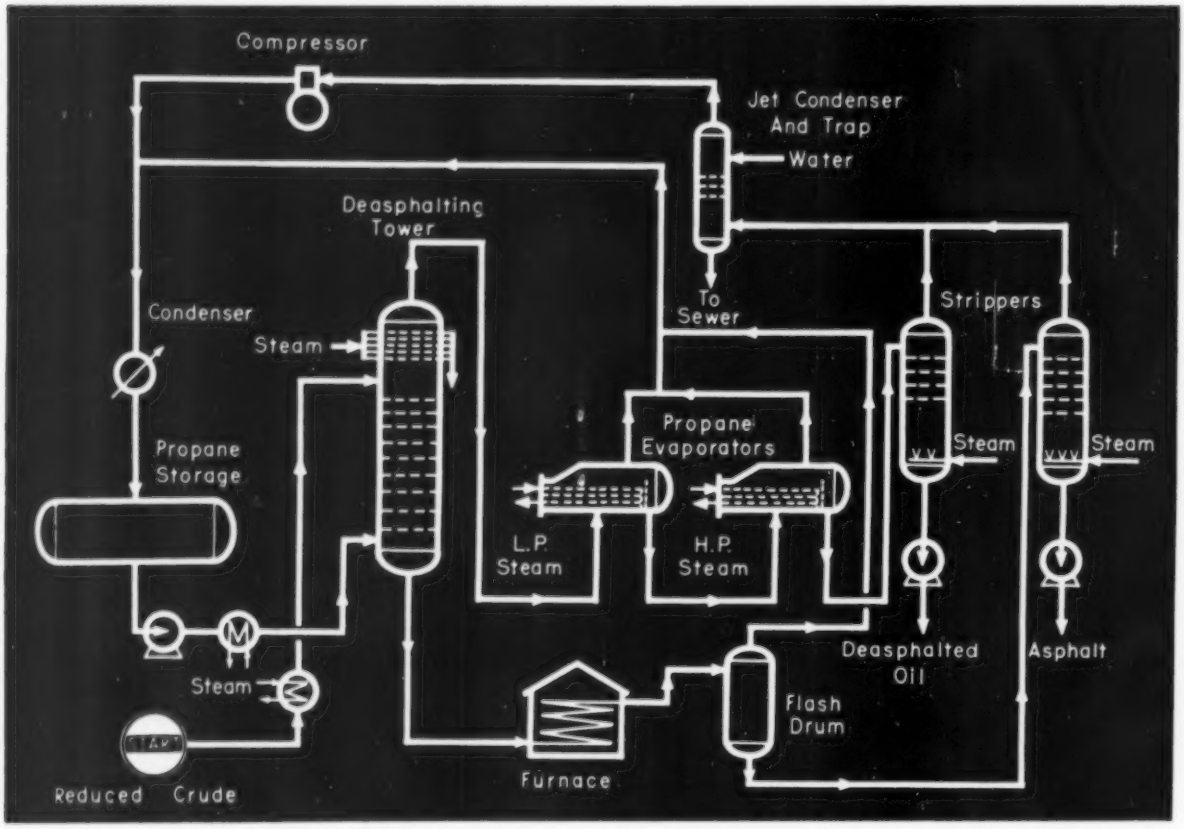


Propane Deasphalting—THE M. W. KELLOGG COMPANY

Application—Propane Deasphalting is a solvent extraction process used to segregate viscous petroleum fractions for finishing into cylinder stocks, bright stocks, and aviation lubes. It is now used almost universally to prepare these stocks from all except the rare crudes containing virtually no asphalt. On Pennsylvania cylinder stocks the same process, called Propane Deresining, is used to improve the color and carbon residue of the deresined oil to be finished as bright stock.

Charge—Vacuum reduced crude of appropriate length. When producing a lubricant of constant viscosity, shortening the charge stock has the effect of decreasing yield and improving color and carbon residue.

Product—Deasphalted oil which, if produced from a reduced crude of proper length, is normally of specification color and carbon residue after only solvent treating and dewaxing.

Description—As shown in the accompanying flow chart, the feed is brought to proper extraction temperature by exchange with exhaust steam or cooling water and charged to the deasphalting tower. Liquid propane, introduced near the bottom of the tower, is contacted counter-currently with the descending heavy oil. Steam coils near the top of the tower, by imposing a temperature gradient, provide reflux so as to maximize the selectivity of the separation.

The deasphalted oil solution withdrawn overhead, which contains most of the propane, is heated under pressure to evaporate the solvent, the heat being obtained largely from exhaust steam. The last traces of propane are removed by direct contact with steam at low pressure in the deasphalted oil stripper.

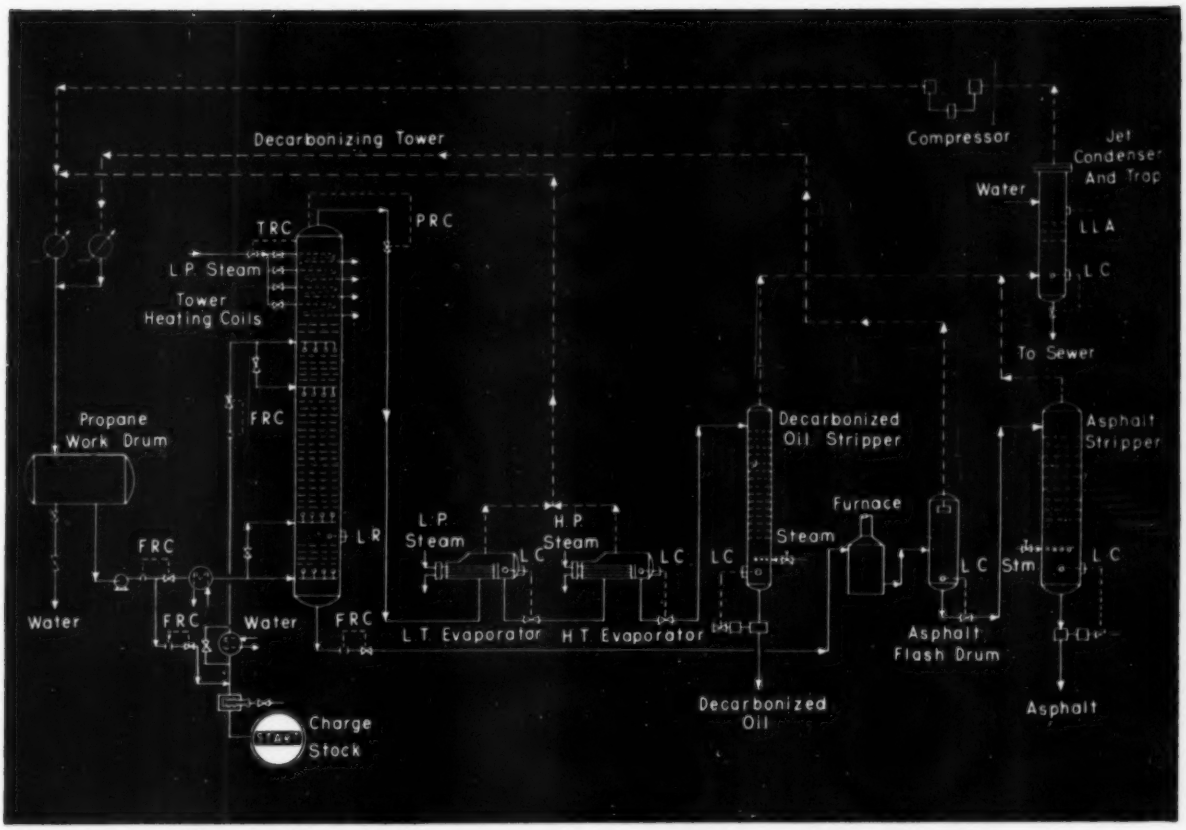
The asphalt solution from the bottom of the deasphalting tower is heated in a furnace, following which propane vapors are separated in a pressure flash drum. The final stripping is accomplished at low pressure as with deasphalted oil.

Operating conditions in the deasphalting tower depend upon the length of the charge stock, desired viscosity of deasphalted oil and the sharpness of separation required. Normally, the top temperature ranges between 140 and 170 F. and the pressure from 400 to 550 psi. Solvent/oil ratios of 5/1 to 13/1 are used and temperature gradients are usually between 10 and 35 F.

Yields—Typical yields are shown in the table:

	Oklahoma	Iraq	Le Duc	Illinois		Pennsylvania	West Edmond
Reduced Crude:							
Gravity—°API	19.3	7.1	12.1	13.7		25.1	19.3
SSU Vis. at 210 F.	385	4880	2050	1760		220	514
Carbon Residue, Conradson—Weight Percent	7.3	19.7	17.1	13.4		2.76	5.9
Deasphalted Oil:							
Yield—Volume Percent	75.6	34.1	47.1	44.3	50.7	83.7	39.4
Gravity—°API	23.6	20.2	22.7	24.2	23.4	26.6	24.7
SSU Vis. at 210 F.	141	179	199	158	190	144	155
Color ASTM	6	8	6	5	5	4½	4½
Carbon Residue, Conradson—Weight Percent	1.48	2.36	1.7	1.2	1.4	1.1	0.97
Asphalt:						Resins	
Yield—Volume Percent	24.4	65.9	52.9	55.7	49.3	16.3	60.6
Specific Gravity °API	1.0227	1.0039	1.0542	1.023	1.030	0.9529	15.8
Softening Point °F.	144	145	176	135	145	.....	.....
S.F. Viscosity C. 210 °F.	.....	.....	.....	.....	.....	339	.....
Solvent/oil Ratio—Voulme	7.8	9.9	7.9	8	8	12.7	6

Commercial Installations—There are 22 units in the U. S. and Canada and 12 foreign units.



Propane Decarbonizing—THE M. W. KELLOGG COMPANY

Application—Propane Decarbonizing is a solvent extraction process used to recover an additional fraction of catalytic cracking stock from fuel residua.

Charge—Topped or vacuum reduced crude. Decarbonizing can also be used in conjunction with vis-breaking.

Product—Decarbonized and de-metallized oil and a high-grade, straight-run asphalt. Decarbonized oil is a premium catalytic cracking stock.

Description—As shown in the accompanying flow chart, the feed is reduced in temperature by heat exchange and cooling and charged to the decarbonizing tower. Liquid propane, introduced near the bottom of the tower, is contacted counter-currently with the descending heavy oil. Steam coils near the top of the tower, by imposing a temperature gradient, provide reflux so as to maximize the selectivity of the separation.

The decarbonized oil solution withdrawn overhead is heated under pressure to evaporate solvent, most of the heat being obtained from exhaust steam. The last traces are removed by direct contact with steam at low pressure in the decarbonized oil stripper.

The asphalt solution from the bottom of the decarbonizing tower is heated in a furnace, following which solvent vapors are separated in a pressure flash drum. The final stripping is accomplished at low pressure as with decarbonized oil. Flux oil may be blended with the hot asphalt before pumping to fuel oil storage, or the uncut fraction may be withdrawn directly for asphalt finishing or vis-breaking.

Operating conditions in the decarbonizing tower depend upon the length of the charge stock, depth of extraction and the sharpness of separation required. Normally, the top temperature ranges between 160 and 190 F. and the pressure from 450 to 600 psi. The solvent ratio and temperature gradient are determined by the selectivity requirements.

Yields—Typical yields and product properties shown below are illustrative only.

	A	B	C	D	E	F	G
Reduced Crude:							
Volume Percent Crude	11.1	19.8	22.2	32.3	29.2	20.0	16.0
Gravity, °API	11.3	13.0	5.3	10.1	12.0	6.3	9.6
Conradson Carbon, Weight Percent	15.0	13.3	21.5	16.0	12.1	22.2	18.9
SSU at 210 F	2,193	812	...	...	526	...	...
SFs at 210 F	...	...	772	162	...	990	179
SiO_2-free ash, ppm	489	149	350	237	936	848	265
Metals, ppm:							
Vanadium	23.1	27.6	84.1	61.6	27.6	136.0	30.0
Nickel	14.2	11.9	27.6	19.9	16.0	139.0	46.6
Iron	18.2	56.6	13.2	6.7	13.2	93.0	39.3
Copper	...	...	3.7	0.8	1.6	0.94	1.4
Decarbonized Oil:							
Volume Percent Charge	62.9	69.0	35.0	47.0	66.0	52.8	67.8
Gravity, °API	19.0	20.5	19.3	20.3	19.6	18.3	17.8
Conradson Carbon, Weight Percent	4.2	2.6	4.3	2.6	2.2	5.3	5.4
SSU at 210 F	294	163	193	...	113	251	250
SiO_2-Free ash, ppm	9.2	8.9	8.8	7.6	6.2	25.5	10.7
Metals, ppm:							
Vanadium	1.23	0.36	1.88	0.73	1.34	2.3	1.4
Nickel	1.10	0.56	0.92	0.38	0.99	8.1	3.9
Iron	0.49	0.90	0.96	1.70	0.66	3.5	Trace
Copper	...	...	0.03	0.04	0.15	0.03	0.02
Asphalt:							
Volume Percent Charge	37.1	31.0	65.0	53.0	34.0	47.2	32.2
Specific Gravity	1.076	1.086	1.087	1.059	1.083	1.119	1.120
R & B Soft. pt., °F	188	196	142	132	171	246	224
Percent of Metals in reduced Crude rejected to asphalt Fraction	97.1	98.8	99.1	98.6	96.6	98.2	97.1

Commercial installations—At present, five Propane Decarbonizing units with a total capacity of 63,000 barrels per day are in operation. Others are being engineered or planned. In addition, several Propane Deasphalting units are employed in decarbonizing operations on a part-time basis.

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OFFICE OF THE PRESIDENT

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Congratulations on your completion of the ammonia-urea plant you built for us at Omaha, Nebraska, well ahead of the time schedule and comfortably within our cost estimates. It was a big, complicated job, involving some of our new process developments never before incorporated in a commercial plant. Few craftsmen were available familiar with the type of construction required, which was new to the Omaha area. In spite of these and other difficulties, it was altogether a fine performance and your organization is entitled to commendation for it.

Best personal regards.

Sincerely yours,

Hugo Riemer
President

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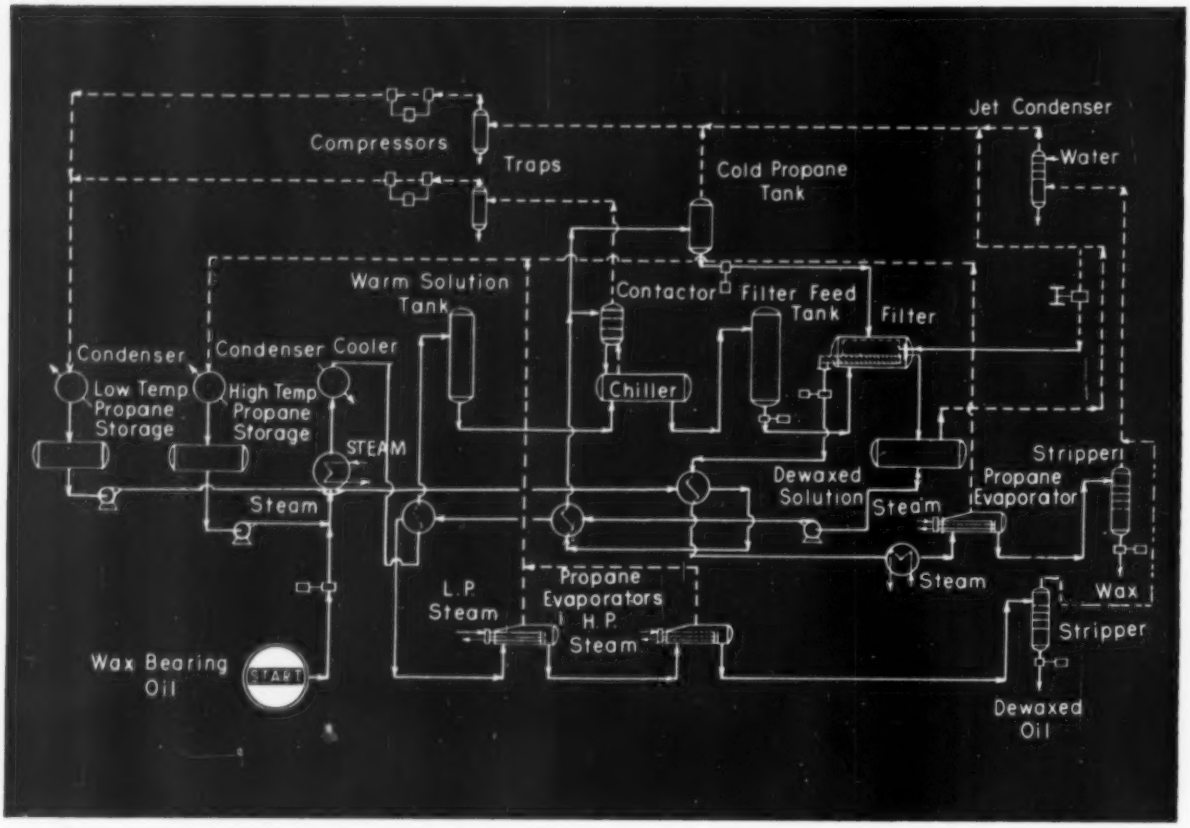


Propane Dewaxing—THE M. W. KELLOGG COMPANY

Application—The process is applied to dewaxing lube oil stocks. These units have also been applied to the Propane De-Oiling Process, where propane is used to remove oil from crude waxes produced in the dewaxing process.

Charge—Charge oils ranging from paraffin distillates of 70 SUS at 100 F. to cylinder stock of 250 SUS at 210 F. viscosity have been handled.

Product—Zero or lower pour test oils with exceptionally low cloud points as well as waxes of low oil content.

Description—Oil and propane are continuously charged through a heater which insures that all wax crystals are dissolved. The charge solution, after being held briefly in the warm solution tank, enters one of two parallel chillers in which its temperature is reduced at a controlled rate to filtering temperature by evaporation of propane. During chilling, wax crystals form and remain suspended in the propane-oil solution. The chilled slurry is charged to one or more continuous rotary filters via a filter feed tank. The wax cake on the filter is washed with cold propane to free it of oil, after which it is discharged to the wax recovery system. The filtrate, which comprises the wax-free oil together with most of the solvent and wash propane, is processed in a similar recovery system.

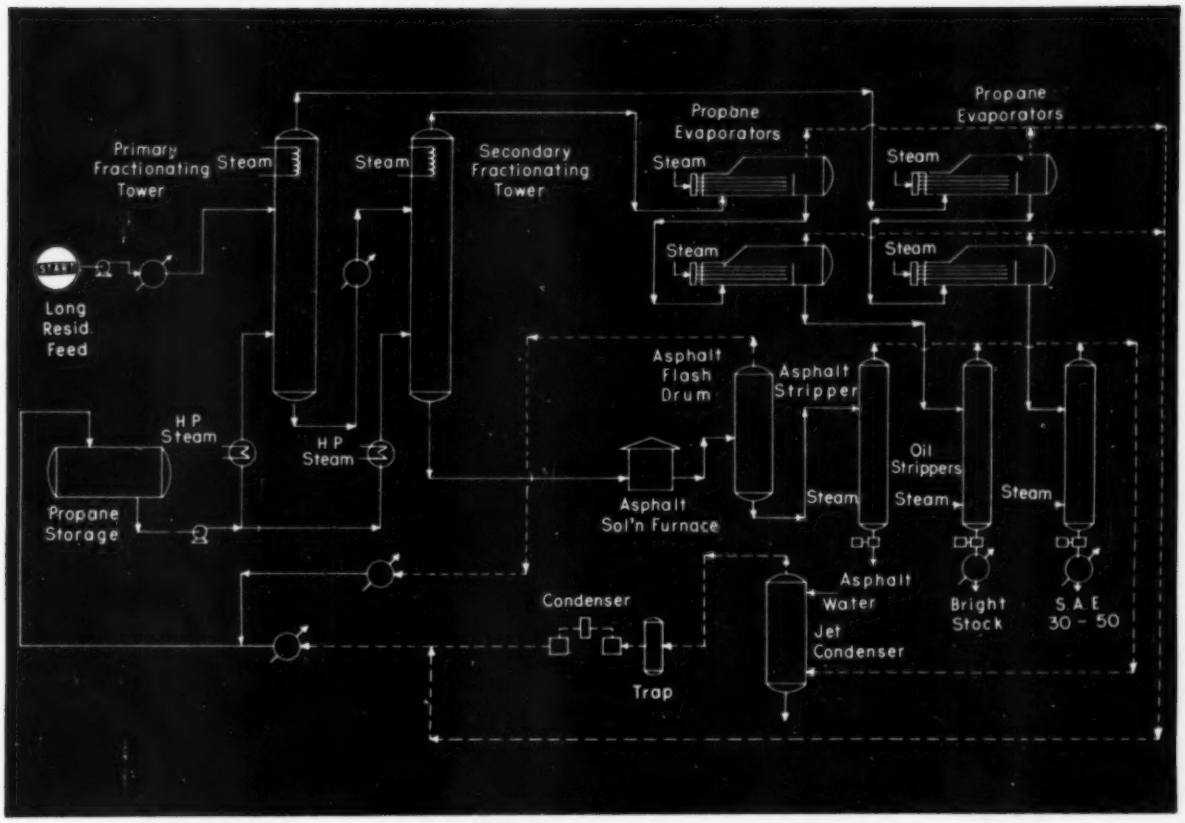
In brief, the product recovery systems comprise steam-heated evaporators operated under sufficient pressure that the vaporized propane can be condensed for re-use with plant cooling water, followed by direct steam strippers held at atmospheric pressure. Only the traces of propane removed in the strippers, plus that vaporized during the chilling operation, require compression.

The simplicity and economy of the process result largely from the fact that a single fluid—ordinary propane—serves as solvent, as diluent, as refrigerant and (in vapor form) as blanketing gas and filter blow-back. In dewaxing oils of varying viscosities, the only solvent adjustment required is the ratio of propane to oil. By merely lowering the pressure of the charge oil-solvent mixture evaporation of solvent occurs with consequent refrigerating effect.

Yields—The following table gives the yields and inspections on four lubricating stocks:

	Propane Deasphalted Phenol Treated 15 Percent E. Texas Reduced Crude	Phenol Treated E. Texas Heavy Distillate	Propane Deasphalted Phenol Treated W. Edmond SAE 70 Stock	Propane Deasphalted Phenol Treated Okla. City SAE 40 Stock
Propane, Volume Percent	300	250	300	300
Filtering Temp., F.	—34	—35	—40	—41
Dewaxed Oil Volume Percent	61.6	67.7	85.5	81.1
Inspections Waxy Oil:				
°API Gravity	29.7	32.0	27.4	30.1
SSU Viscosity at 210 F.	93.1	57.3	132	72.7
Color ASTM	4½—	2—	3½—	2—
Carbon Residue, Percent	0.20		0.25	0.06
V.G.C.	.795	.790	.803	.797
Dewaxed Oil:				
°API Gravity	27.6	28.9	26.7	28.7
SSU Viscosity at 210 F.	118.4	66.2	150.0	79.6
Color ASTM	4½—	2—	3½—	2—
Pour Point, F.	0	0	0	—5
Carbon Residue Percent	0.26	0.03	0.30	0.05
Viscosity Index	95	92.1	91.1	92.1
V.G.C.	.804	.808	.807	.804

Commercial Installations—There are eight domestic and four foreign units in operation.



Propane Fractionation—THE M. W. KELLOGG COMPANY

Application—Propane Fractionation is a development of propane deasphalting in which two or more grades of raw lube stock are segregated by liquid propane extraction.

Charge—Selected long vacuum residua containing both bright-stock and heavy neutral fractions.

Product—Raw heavy neutral and bright stock of distinctly lighter color, lower carbon residue, and higher viscosity index than corresponding fractions from vacuum distillation. Asphalt equivalent to that obtained in propane deasphalting is also produced.

Description—Oil to be fractionated is charged to the primary tower and countercurrently extracted with liquid propane. Steam coils installed in the tower heat the solution to a temperature such that only the heavy neutral is dissolved in the light phase and taken off overhead. The bottoms product contains oil to be subsequently recovered and asphalt.

Primary tower overhead flows in series through two evaporators in which the bulk of the propane is removed at high pressure and returned to the process without compression. After the evaporators, final traces are removed from the neutral product in a steam stripper.

Bottoms from the primary tower are passed to the secondary fractionation tower, where at lower temperature and pressure, propane countercurrently extracts the raw bright stock from the asphalt. Operation of the tower is similar to that of the primary fractionator just described. The oil-propane solution is removed from the top of the tower and passed through two evaporators and a stripper to separate the product from the propane, which is returned to the system.

Bottoms from the secondary fractionator are passed first to a furnace and then to a flash drum in which the bulk of the propane is vaporized and separated. Remainder of the propane is removed from the asphalt by steam stripping.

A third fractionation section, designed to operate at a still lower extraction temperature, may be added to the above system to increase the melting point of the final asphalt product and recover a high viscosity "resin" fraction if this is desirable.

Yields—(Comparison of vacuum distillation and propane fractionation.)

	Medium Neut.	Cylinder Stock	Residue
Vacuum Distillation			
Yield Percent on Crude	13.0		14.3
Position in Crude—Percent	72.7–85.7	Not Produced	85.7–100
Viscosity SSU at 210 F.	90.7		6840
Gravity—°API	19.0		7.3
Color—ASTM	5 (D)		
Conradson Carbon—Weight Percent	2.1		21.4
Dewaxed (0°F. Pour Pt.) V.I.	50.2		
Propane Fractionation			
Yield Percent on Crude	8.6	3.2	11.5
Position in Crude—Percent	76.7–85.3	85.3–88.5	88.5–100
Viscosity SSU at 210 F.	94.0	239	
Gravity—°API	24.3	18.0	1.6
Color—ASTM	4½	5	
Conradson Carbon—Weight Percent	0.66	2.6	
Dewaxed (0°F. Pour Pt.) V.I.	80.6		
Softening Pt. (R & B) °F.			130

Commercial Installations—At the present time there is one commercial propane fractionation plant in operation producing two conventional lubricant grades. In addition three propane deresining units refractionate bottoms (below bright stock) into two or more high viscosity resin cuts.

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1. Alkylation Contactor

Provides high octane and rerun yield with either H_2SO_4 or HF catalyst. Features high internal isobutane circulation, large cooling capacity at low MTD and cooling by water or refrigeration.

Built in a number of sizes up to a volumetric capacity of 8900 gallons with an internal circulating rate of 50,000 GPM and containing 6700 square feet of cooling surface with an overall service heat transfer rate of 60 BTU per square foot per hour per degree Fahrenheit MTD.

2. General Purpose Contactor . . . Horizontal

Provides any degree of mixing short of homogenization. Adaptable to any mixing problem where one or more of the components is a liquid. Mixes liquids with liquids or liquids with solids. Built in a great range of sizes all the way from small pilot scale machines having a volumetric capacity of only 300 cc and an internal circulation rate of 25 GPM, up to commercial machines having a volumetric capacity of 60 gallons and an internal circulation rate of 9000 GPM.

Furnished with internal tube bundle for heating or cooling if required.

3. High Dispersion Contactor . . . Vertical

Recommended for either batch or continuous mixing of liquids with liquids or liquids with solids where large heat input or removal is simultaneously required. Widely used for making soaps and greases with very short time cycles and great uniformity of product. Heating medium is circulated through both the double walled circulating tube and the jacket and the product mix is circulated at high velocity on the other side of these surfaces. Built in volumetric capacities 100, 400, 1000, 2000, 3000 and 6000 pounds. See Page 277 for full details.

4. Double Stirrer Process Kettle

For exceptionally good mixing of more viscous fluids through the use of two counter-rotating assemblies each provided with efficient axial flow type impeller blades. The outer rotative assembly carries blades for completely scraping the interior wall of the kettle. The complete interior of the vessel is machine bored to insure true form and uniform smoothness for most effective scraping action. Heating jacket is provided on the outer shell.

Built in sizes of 400, 1000, 3000, 8000, 15,000 and 22,500 pounds capacity.

5. Flash Evaporator

A very efficient device for removing volatiles from liquids. Used for the dehydration of lubricating oils and sulfonates, the restoring of electrical oils to high dielectric, deodorization of oils and waxes and contacting of liquids with gases.

Heated feed is atomized from the periphery of a specially designed rotor into a vacuum or into an atmosphere of the gas to be contacted. Product liquid is removed either by an outside pump or by a centrifugal pump mounted in the evaporator on the same shaft with the rotor.

Built in sizes of 3', 4', 6' and 8' diameter, having nominal capacities of 30, 75, 150 and 300 GPM when dehydrating lube oils to brightness.

PROCESSES

1. Effluent Refrigeration Alkylation Process

An improvement in the sulfuric acid alkylation process whereby the total hydro-carbon effluent from the settler is reduced in pressure and utilized as the refrigerant in the cooling elements of the reactor. Vapors thus evolved from the effluent, principally isobutane, are compressed, condensed, evaporatively cooled and returned to the reactor. This effluent refrigeration recycle provides six volumes of isobutane per volume of olefin in addition to whatever isobutane is available from fractionation. No isobutane is permitted to vaporize from the reaction zone where isobutane is most needed. See page 200 for complete details and flow sheet.

2. Stratco Hot Lube Treating Process

A continuous process for treating lubricating distillates or other oils by contacting with sulfuric acid at controlled elevated temperature and immediately thereafter separating the sludge, then neutralizing and steam-water washing. Compared to conventional agitator treatment, this process reduces both acid consumption and oil losses by 50% to 70% and produces a fluid, easily pumped sludge. Modifications of this process make it ideal for the manufacture of oil soluble sulfonates and white oils.

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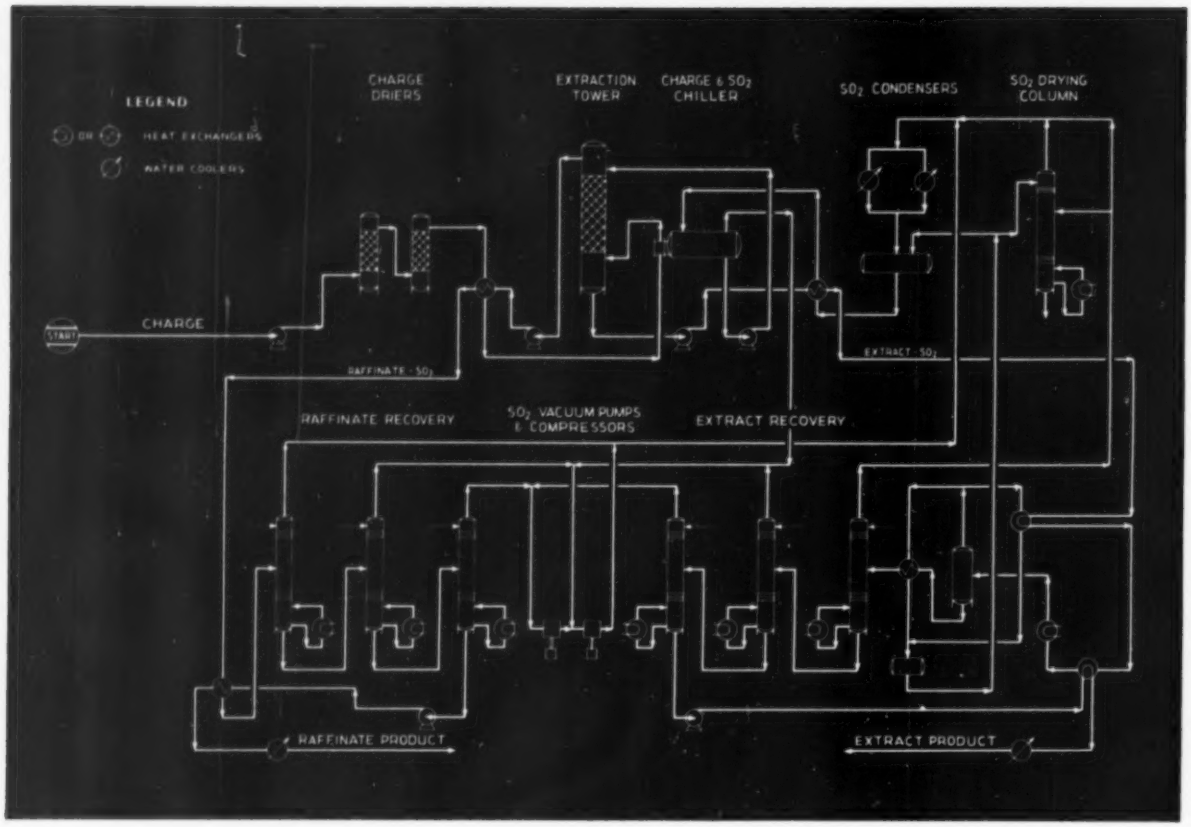


SO_2 Extraction—STONE & WEBSTER ENGINEERING CORPORATION—BADGER PROCESS DIVISION

Application—The SO_2 extraction process is used to remove aromatic hydrocarbons and sulfur bearing compounds from paraffinic and naphthenic hydrocarbons to produce high quality raffinate products. The process can also be used to recover high purity aromatics.

Charge—The fractions range in boiling point from naphtha and catalytic reformates through kerosene, gas oils, cycle oils from catalytic cracking and high and medium lubricating oils. Minor modifications in design permit blocked-in operation for a wide variety of charge stocks.

Product—The extraction of the aromatic hydrocarbons may serve two purposes; the quality of the remaining oil may be upgraded or the aromatic fraction may be the desired product.

Description—The accompanying diagram illustrates the flow in a plant designed for handling stocks ranging from light naphthas to light lube oil distillates.

The charge stock is pumped through a coalescer for the removal of free water and then through a dryer. The charge oil is next cooled by heat exchange with raffinate solution and further by refrigeration with SO_2. It is then introduced into the lower section of the packed extraction tower.

In the extraction tower, the charge oil is contacted with chilled liquid sulfur dioxide and is separated into a refined oil phase and an extract phase. The latter contains most of the SO_2 used for the extraction. The raffinate phase leaves the extraction tower at the top, while the extract phase accumulates in the base section. Both phases are pumped into their respective solvent recovery sections in which the SO_2 contained in the oil is removed in a series of evaporators.

The process consumes liquid sulfur dioxide at the rate of about 0.15-pound per barrel of charge. This loss is due to leakage, venting of the condensers, and incomplete recovery from the products and from the water removed in the drying tower.

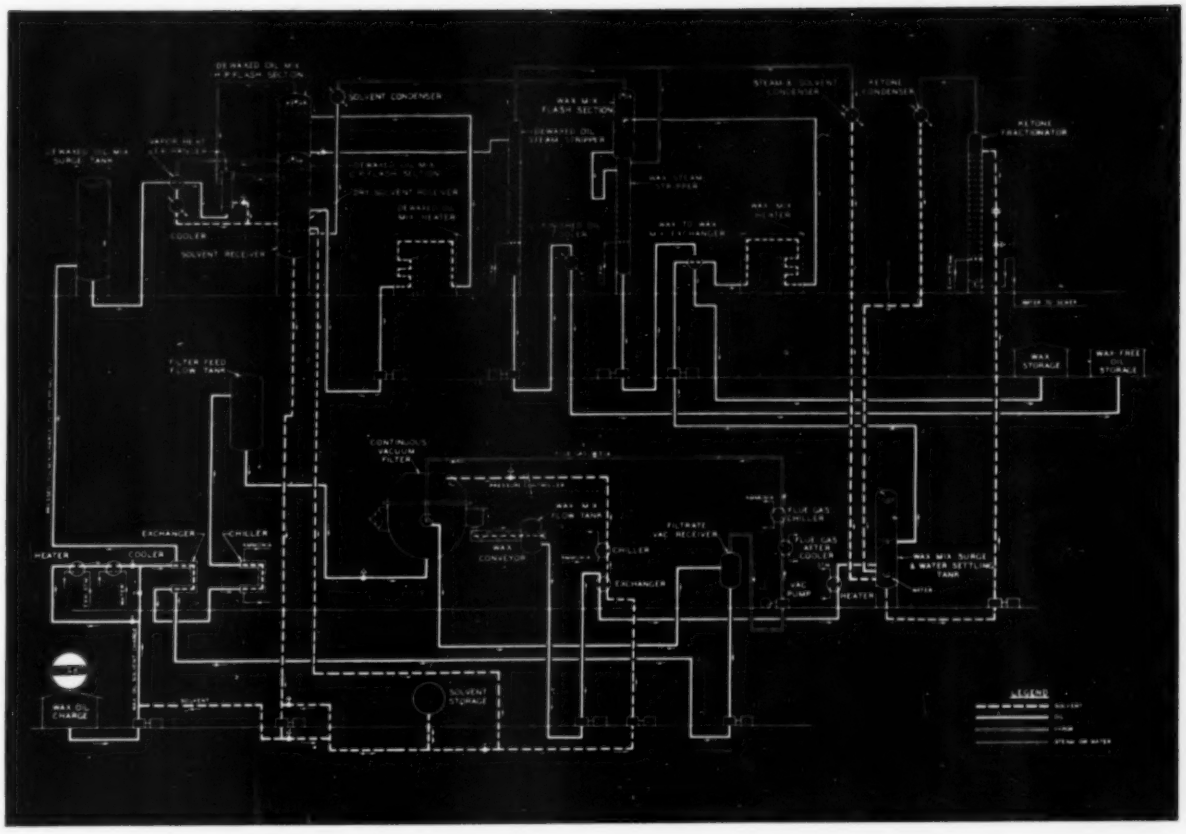
Operating Conditions—Extraction temperatures of —20 F. to +60 F. are used, the lower temperatures for platformate and kerosenes and the higher temperatures for high pour point stocks. The high selectivity of SO_2 permits the use of a very low SO_2 treat, 0.62 to 1.65 vol percent of the charge, coupled with a low number of extraction stages, usually 2-5.

Yields—High purity benzene, toluene and xylenes are extracted from platformates with simultaneous individual aromatic recoveries greater than 97 percent.

Lamp oils are improved to a smoke point of 30-40 with removal of 75-90 percent of the original sulfur and 85-95 percent of the original aromatics present in the feed. Raffinate yields vary from 75-90 percent by volume.

Treatment of gas oils produces raffinates containing 5 percent or less of aromatics and extracts of an aromaticity of 70-80 percent. The process produces premium quality diesel fuels from straight run or cracked stocks. The treatment of catalytic cracking cycle stock reduces the coke laydown in subsequent cracking by 50 percent or more.

Commercial Installations—The total installed charge capacity of SO_2 extraction plants in the U. S. A. and foreign countries is about 200,000 barrels per day. Plants for a total charge capacity of 114,000 barrels per day have been built by the Badger Process Division of Stone & Webster Engineering Corporation.



Solvent Dewaxing—TEXACO DEVELOPMENT CORPORATION

Application—The process is used for the removal of wax from lubricating oil stocks.

Charge—Either distillate or residual stocks of practically any viscosity in the raw or refined state from any crude source can be dewaxed.

Product—Dewaxed oils with pour points equal to or within a few degrees of the dewaxing temperature.

Description—The accompanying flow diagram shows the flow through the unit. In operation, the dilution solvent is introduced into the wax-bearing oil stream in such amounts at selected points in the chilling cycle as to insure a wax crystal structure and liquid viscosity most suitable for filtration.

The chilled charge mixture flows from the double pipe chillers through a filter feed tank to drum-type vacuum filters in which compartmentized, cloth covered drums rotate, half submerged in enclosed filter cases. A wax-free oil filtrate solution is drawn through the filter cloth to filtrate tanks in which the vacuum, which induces filtration, is maintained. The wax cake deposited upon the drum during filtration is washed with cold solvent as it emerges from the liquid level in the filter. Just before each of the filter drum compartments reaches the wax deflector, flue gas at low pressure is admitted through a blow-back connection to the underneath side of the filter cloth. The bond between wax and cloth is broken and the washed wax falls into the wax discharge compartment. Controllers in the flue gas piping maintain an atmospheric pressure in the filter hood.

The filtrate from the filtrate receiver is pumped through the double pipe exchangers to evaporators for recovery of the solvent. Heat for evaporating the solvent from the dewaxed oil solution and the wax mix may be supplied by either steam or fire heaters.

The solvent employed generally consists of a mixture of methyl ethyl ketone and an aromatic solvent (benzol, toluene or a mixture of the two). Because of its relatively low boiling point, the solvent can readily be recovered from the dewaxed oil and wax solutions in simple evaporating equipment for continuous re-use.

Operating Conditions—Dilution solvent dosages vary from a solvent-to-oil ratio of 1.0:1 to as much as 4.0:1 depending upon the nature and viscosity of the charge stock. The temperature for dewaxing is dependent upon the desired pour point of the dewaxed oil and is equal to or only a few degrees below the pour point. Low pressures exist throughout the process.

Yields—The yields of dewaxed oil are dependent upon the wax content of the charge stock. Practically complete separation of oil from wax is obtained by the use of the cold displacement wash applied on the filter.

Commercial Installations—The first commercial unit was installed in 1927 and in the intervening time, 65 units have been installed. Four additional units are under contract for construction.

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10. Phillips Chemical, Crane, Texas
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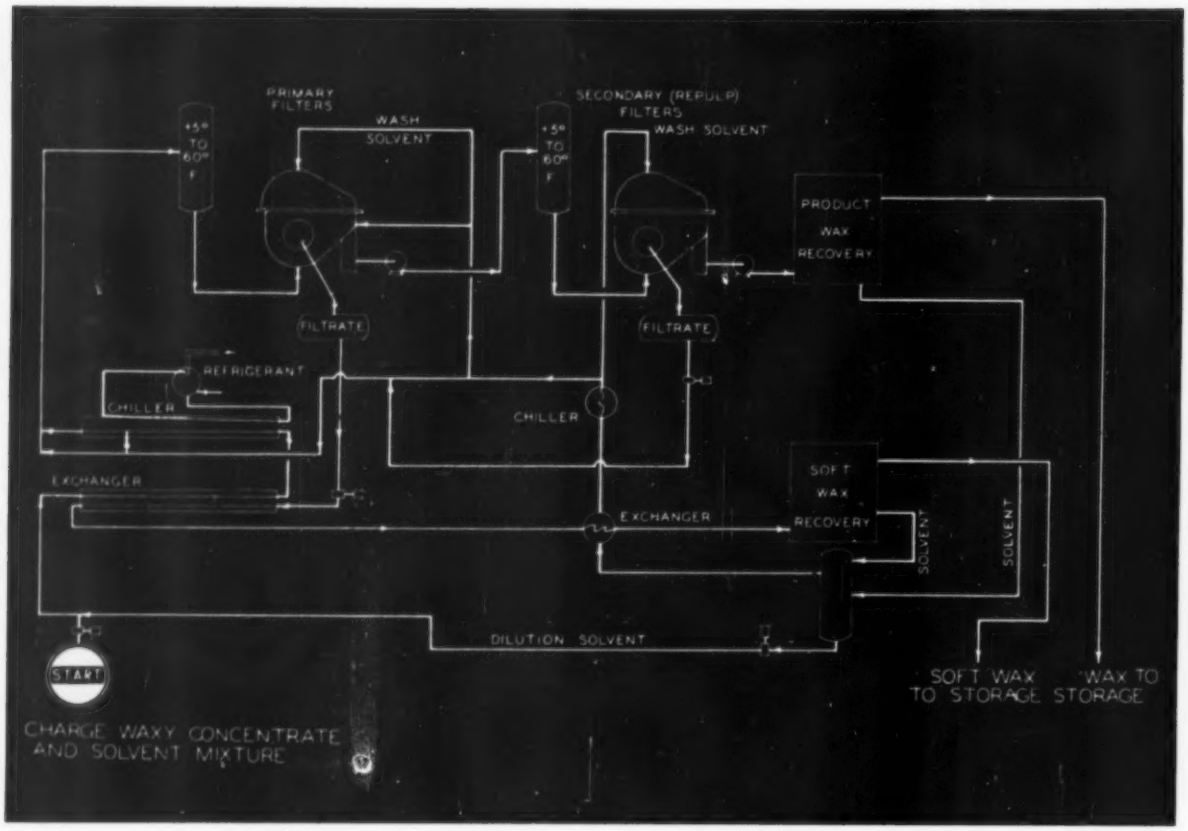


Wax Fractionation—TEXACO DEVELOPMENT CORPORATION

Application—The process is operated for the production of wax of low oil content.

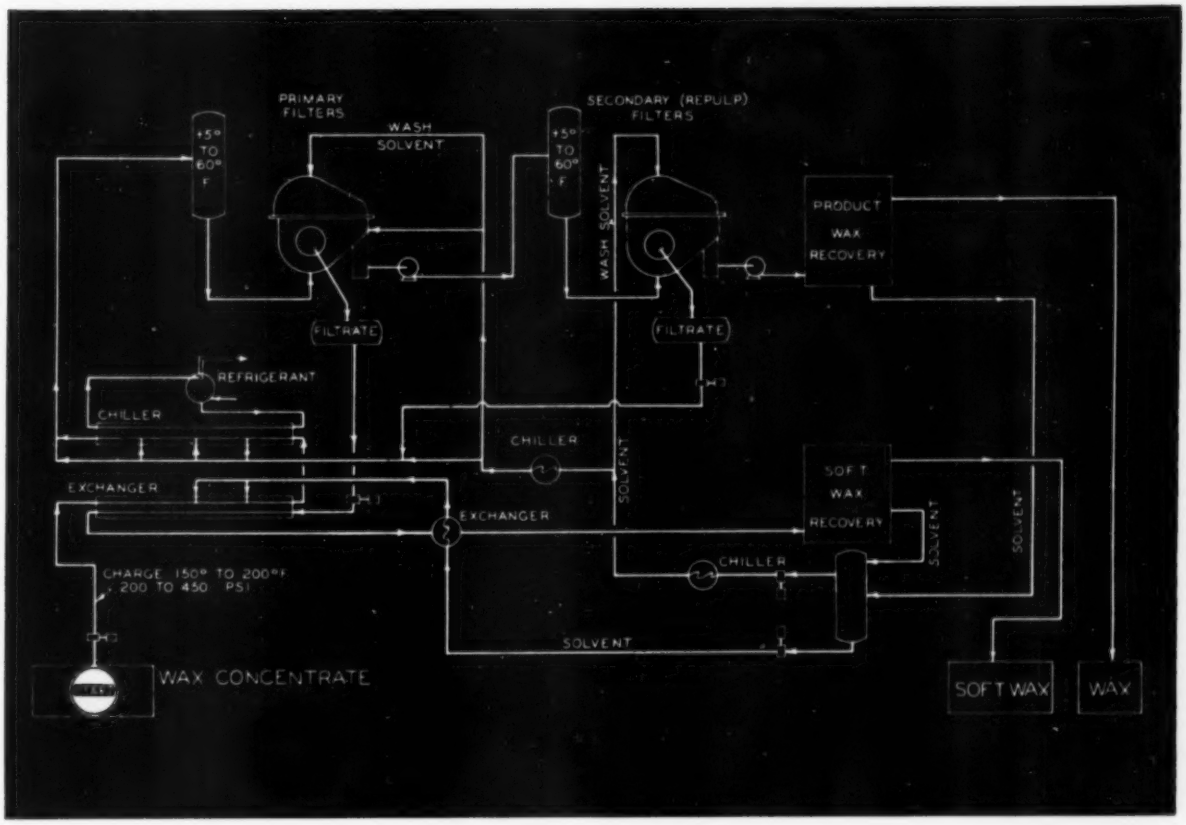
Product—Crystalline and micro-crystalline waxes with melting points depending upon the nature of the charge stock can be produced by this process. Crystalline waxes which consistently show oil contents by ASTM analysis that are below 0.5 percent can be produced. Depending upon the source of the raw waxy concentrate, finished micro-crystalline waxes can be produced which, without additives of any kind, have melting points as high as 200 F. and asphalt penetrations at 77 F. as low as one.

Descriptions—The process employs an operating technique involving the crystallization of wax or a selected portion of the wax contained in a waxy concentrate in the presence of a substantial amount of solvent, added to the charge stock before any of the wax is crystallized. The solid wax is separated from the liquid phase by filtration at a temperature suitable for the desired degree of fractionation.

Typical of the combined operation of the Solvent Dewaxing and Wax Fractionation process is a case in which low pour point dewaxed oil and wax of low oil content are produced concurrently. In the operation, a mixture of the wax-bearing charge stock with a substantial amount of solvent is chilled in double pipe scraped surface chilling equipment to a temperature suitable for the production of dewaxed oil of the desired pour point. The mixture is then filtered and the oil-bearing solution in the wax cake is washed continuously from the wax by displacement with cold solvent. The wax cake is continuously discharged from the primary filters and heated until the wax is totally dissolved in the solvent. Additional warm solvent is blended with the wax cake solution and the mixture cooled in double pipe scraped surface equipment to a predetermined temperature necessary to crystallize the desired wax fractions and obtain the proper quality of wax. The recrystallized wax is then continuously separated by means of a second filter on which the wax receives a final wash. The wax cake from this filter is pumped to the solvent recovery system from which the solvent-free product wax of low oil content is recovered. The filtrate from the secondary filter containing a small amount of oil and undesirable soluble wax fractions is pumped to the solvent recovery system from which the "soft" wax is delivered to storage tanks.

Over-all solvent dosages for a combined dewaxing and wax fractionation operation vary from a solvent-to-oil ratio of approximately 3.5:1 for low viscosity lubricating oil distillate stocks to 9.0:1 or more for viscous residual stocks.

Commercial Installations—Twenty-nine commercial installations employ the Wax Fractionation process in the production of high quality waxes. Two additional units are under contract for construction.



Wax Manufacturing—TEXACO DEVELOPMENT CORPORATION

Application—The process is operated for the production of oil-free wax.

Product—A full range of waxes with melting points from below 120 to above 170 F., depending upon the nature of the charge stock, can be produced. Crystalline waxes consistently show oil contents by ASTM analysis that are below 0.3 percent and with certain types of crystalline waxes below 0.1 percent.

Description—The process is characterized by an operating technique involving the crystallization of wax or a selected portion of the wax contained in the petroleum oil or waxy concentrate by first cooling in the absence of solvent or in the presence of a limited and carefully controlled amount of solvent; then adding solvent in small increments until all of the desired wax types have crystallized. Sufficient cold solvent is then added to the cooled waxy slurry to permit separation of the solid wax from the liquid phase by filtration.

Typical of the combined operation of the Solvent Dewaxing and Wax Manufacturing process is a case in which low pour point dewaxed oil and wax, that for practical purposes is oil-free, are produced concurrently. In this operation, the wax-bearing charge stock is cooled without dilution solvent. After the wax has started crystallizing, a small amount of solvent is added; chilling of the mix is continued and as more wax crystallizes, small proportions of solvent are added as necessary. When the temperature required for the production of 0 F. pour point dewaxed oil is reached, a final amount of solvent is added to bring the mixture to the proper filtering viscosity. The mixture is then filtered and oil in the wax cake is washed continuously from the wax by displacement with cold solvent. The total wax cake is continuously removed from the filter and additional solvent mixed or repulped with the wax slurry at a temperature necessary to retain any remaining oil and low melting point, undesirable wax fractions in solution. The repulped slurry is then continuously filtered on a second filter on which the final wax is again washed. The cake from this filter is pumped to the solvent recovery system from which an oil-free product wax is delivered to storage. The filtrate from the secondary filter containing a small amount of oil and undesirable soluble wax fractions is transferred to the solvent recovery equipment from which the "soft" waxes are delivered to storage. The recovered solvent is continuously returned to the system for re-use.

Over-all solvent dosages for both the dewaxing and wax manufacturing operations vary from a solvent-to-oil ratio of approximately 2.5:1 for low viscosity distillates to 7.0:1 for viscous stocks containing micro-crystalline waxes.

Commercial Installations—Six installations of the Wax Manufacturing process have been made for the production of high quality waxes. One additional unit is under contract for construction.

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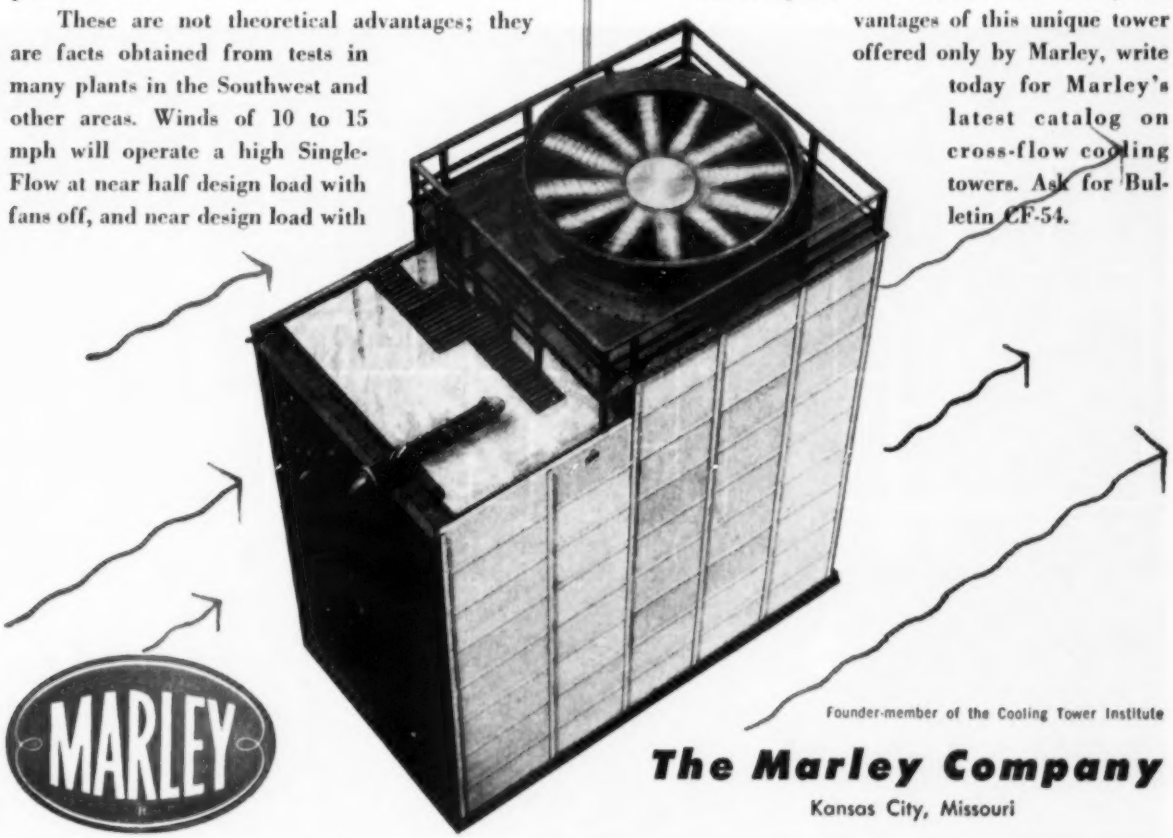

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Doctor Sweetening—THE LUMMUS COMPANY

Application—The process is employed to sweeten gasoline, solvents, and kerosine by converting mercaptans to disulfides.

Charge—Sour hydrocarbon stocks including gasoline, solvents and kerosine.

Description—Doctor sweetening, one of the oldest processes for sweetening gasoline, solvents and kerosine, converts mercaptans to disulfides using sodium plumbite and sulfur,

$$2\,RSH + Na_2\,Pbo_2 \rightarrow PbR_2\,S_2 + 2NaOH$$
$$PbR_2\,S_2 + S \rightarrow PbS + RSSR$$

The PbS is converted back to $Na_2\,PbO_2$ by air blowing in caustic soda,

$$PbS + SO_2 + 4NaOH \rightarrow Na_2\,PbO_2 + 2H_2O + Na_2SO_4$$

In this process, sulfur and caustic soda are consumed. In addition, some PbO is mechanically lost and some must be added to replace solution discarded because of the accumulation of sodium sulfate and sodium salts of cresols and aliphatic acids.

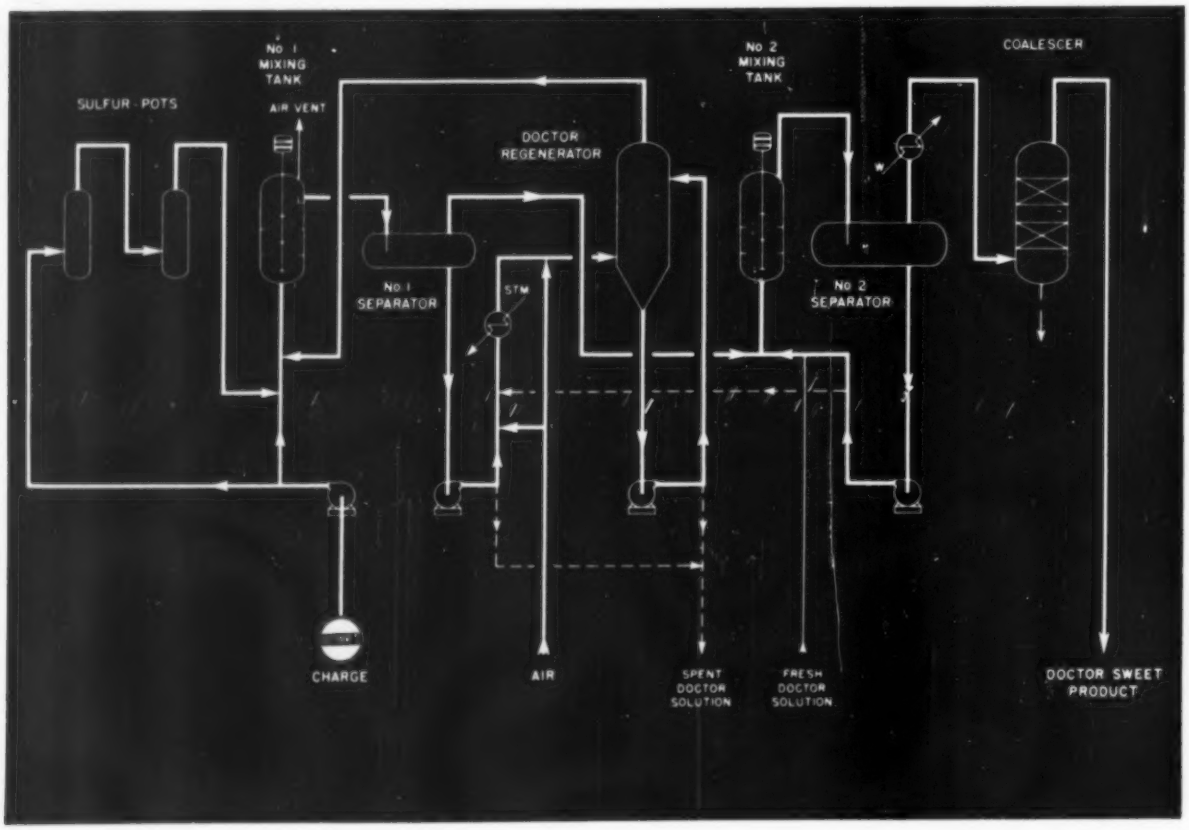
In this unit, a slipstream from the charge stream passes through sulfur pots, and rejoins the main charge stream along with regenerated doctor solution and regeneration air at the bottom of the No. 1 doctor mixer. The sour charge, sulfur solution and regenerated doctor solution are intimately mixed in the No. 1 doctor mixer. Air is vented from the top of this mixer, and the treated charge plus doctor solution flow out through a side nozzle to the No. 1 doctor separator.

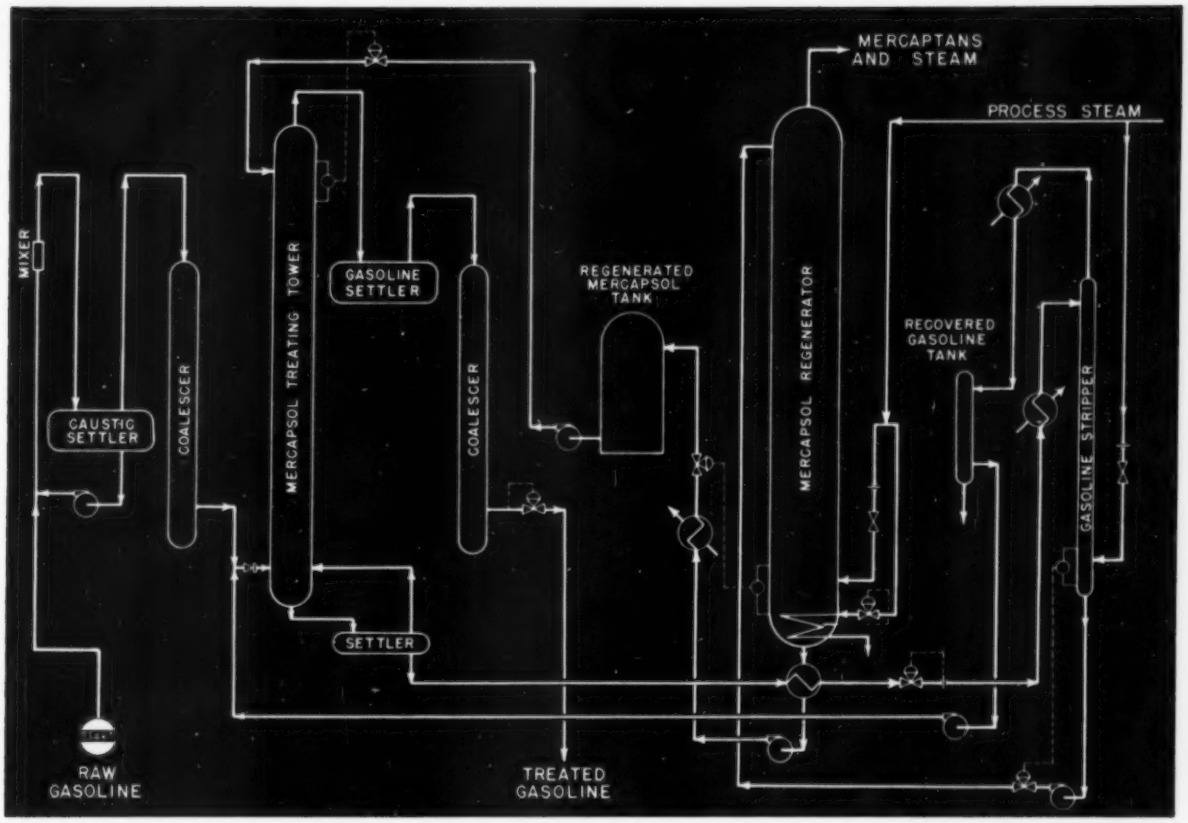
The hydrocarbon stream leaving this separator is combined with second stage doctor solution and mixed in the No. 2 doctor mixer, and then enters the No. 2 doctor separator where most of the doctor solution and lead sulfide formed in the sweetening reaction settle out.

The sweetened stock leaving the No. 2 separator is cooled in the product cooler and passes through the coalescer where residual doctor solution and lead sulfide are removed. Doctor solution from the No. 1 separator is normally circulated through the doctor heater and regenerator, combined with the regeneration air, and delivered back to the No. 1 mixer.

Doctor solution from the No. 2 doctor separator is normally returned directly to the No. 2 mixer. Periodically this solution is pumped forward to the No. 1 mixer and replaced with fresh doctor solution from storage. When this is done an equal volume of spent solution from the No. 1 separator is discarded.

Doctor solution is continuously circulated from the bottom of the regenerator to a nozzle located in the side of the regenerator by means of the doctor pump. This circulation prevents lead sulfide from settling out in the regenerator.





Mercapsol Treating—THE PURE OIL COMPANY

Application—The Mercapsol treating process removes mercaptan sulfur compounds from gasoline thereby providing a method for meeting sulfur and odor specifications and for improving the lead susceptibility.

Charge—Mercapsol treating is especially attractive for use on straight run, thermally cracked or thermally reformed gasolines which are frequently very difficult to treat by other methods.

Product—In most cases a reduction in mercaptan sulfur content of 95 to 99 percent can be accomplished conveniently, and many gasolines can be extracted to doctor sweetness directly. In almost any case the use of a suitable gum inhibitor after Mercapsol treating will result in a doctor sweet product. Since mercaptans are actually removed from the gasoline instead of being converted to disulfides or other sulfur compounds, the product contains less total sulfur than the charge, and the process thus aids very materially in meeting sulfur specifications. Also by virtue of this decrease in sulfur content an improvement in the tetraethyl lead susceptibility of the gasoline is effected, and considerable savings in lead costs can be realized. This is one of the principal advantages of the process. The improved gum inhibitor susceptibility of the treated gasoline is an additional benefit.

Description—The operation of the process is illustrated by the flow diagram. Gasoline is treated in the liquid phase at ambient temperatures. Hydrogen sulfide and other acidic substances, which would otherwise build up in the permanent treating solution, are first removed by contact with low strength caustic solution. The gasoline from this step passes through a coalescer whose function is to remove any aqueous phase which would contain sodium sulfide and other salts. The gasoline then enters the treating tower near the bottom, where it is intimately contacted counter-currently by the descending continuous phase of Mercapsol solution which effectively extracts the mercaptans. From the top of the treating tower the treated gasoline flows through a settler and a coalescer for clarification and on to inhibiting and storage.

Spent Mercapsol solution containing the extracted mercaptans is withdrawn from the bottom of the treating tower into a settler from which the gasoline that separates can return by density difference to the tower. The treating solution as it then flows from the Mercapsol settler contains a small amount of dissolved gasoline which is recovered and returned to the treating tower. Recovery of the dissolved gasoline is accomplished in a small stripper by the use of a small amount of steam which is sufficient for this purpose but not enough to strip much of the mercaptan present. The Mercapsol is then steam stripped of mercaptans in the regenerating tower, and after cooling is stored in the regenerated Mercapsol tank from which it is pumped to the top of the treatinng tower to repeat the cycle.

The Mercapsol treating solution is an aqueous solution of sodium hydroxide containing salts of certain acid oils which act as solubility promoters for mercaptans. With proper precautions against contamination and loss the solution may be used indefinitely.

Commercial Installations—Mercapsol treating is currently being used in two plants of The Pure Oil Company.

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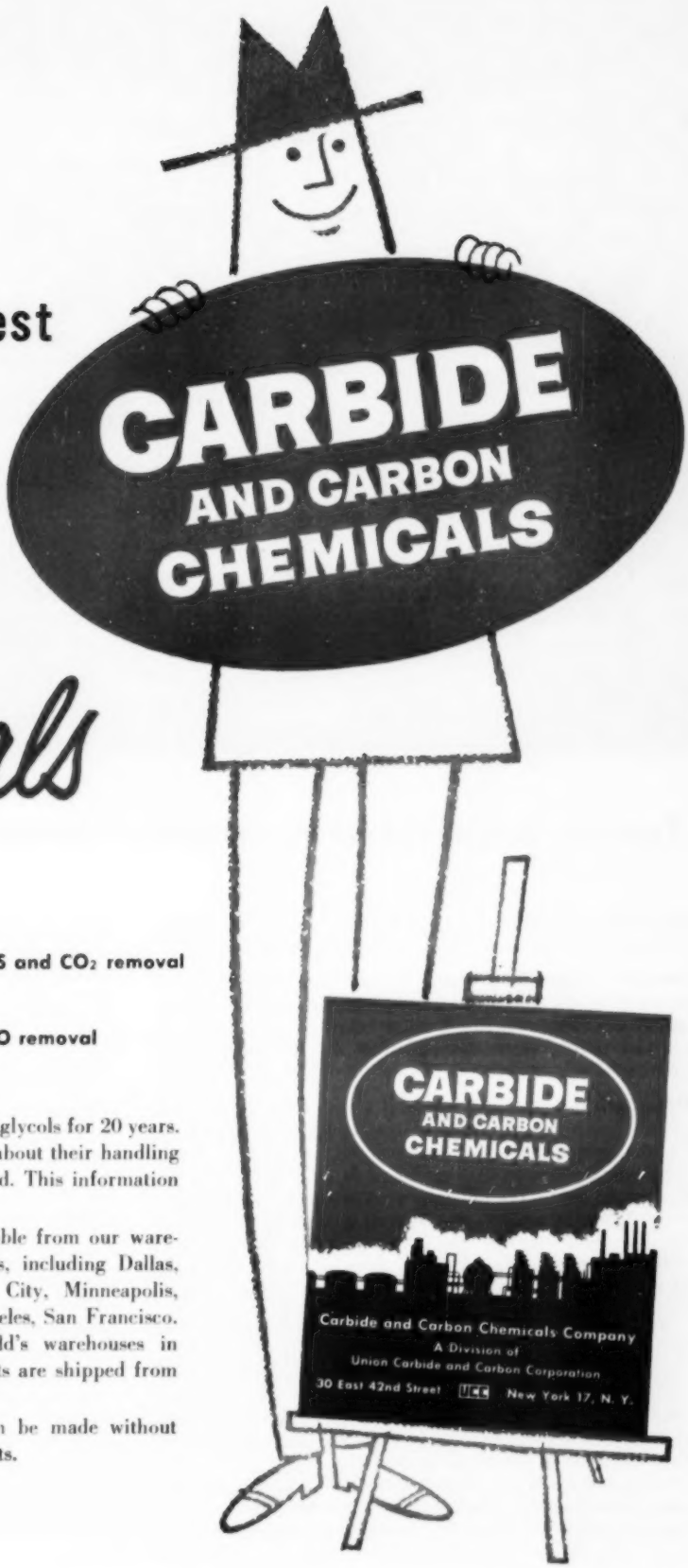

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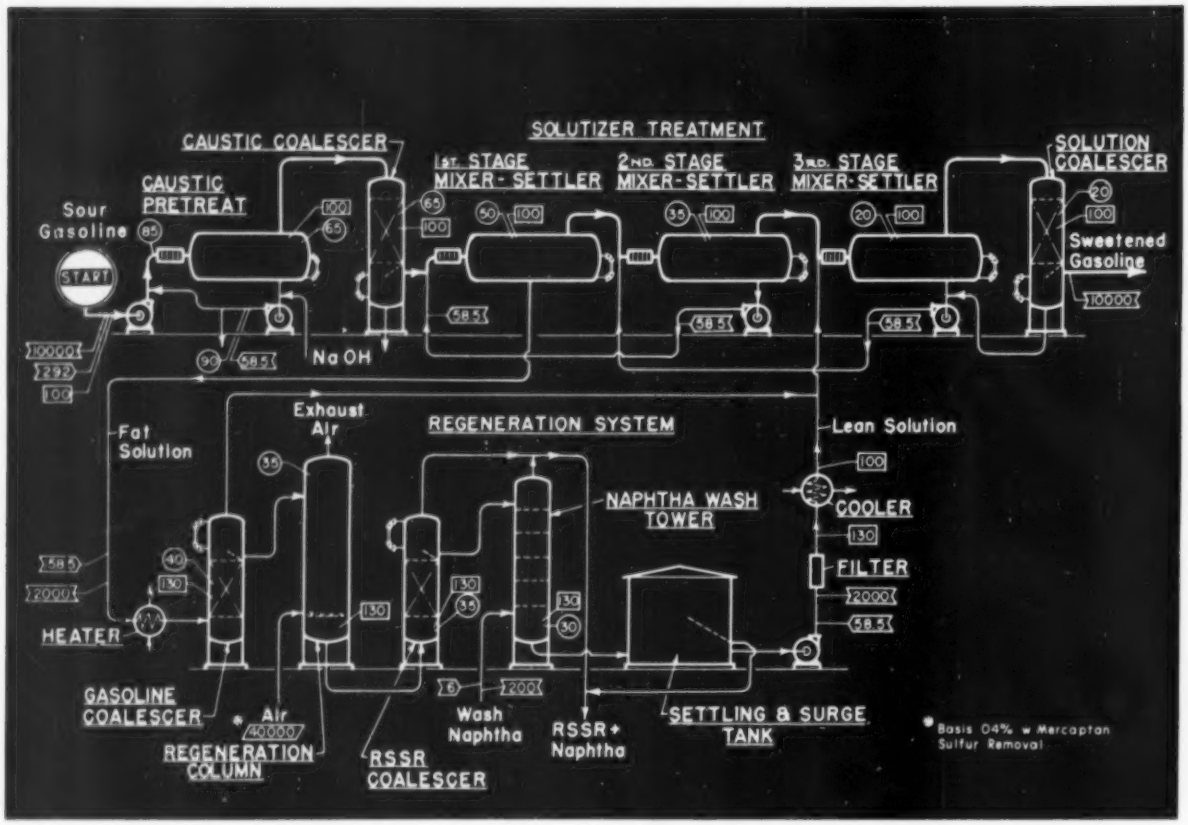


Tannin Solutizer—SHELL DEVELOPMENT COMPANY

Application—The Tannin Solutizer process is a cyclic process—removes mercaptans from sour gasolines.

Product—Mercaptan removal to the "odor sweet" level of 0.001 to 0.003 weight percent mercaptan sulfur is easily achieved when treating a wide range of straight-run or cracked stocks, either low-end-point or full-boiling-range gasolines.

Description—The three essential steps of the process are caustic pretreatment, solutizer treatment, and regeneration. Caustic pretreatment is often necessary to remove acidic components such as hydrogen sulfide and, in some cases, to control the alkyl phenol concentration. A single conventional mixer-settler arrangement is usually satisfactory for this purpose, and the caustic solution may be used until it is essentially saturated. A coalescer follows the caustic settler to minimize contamination of the potassium hydroxide treating solution with sodium ion.

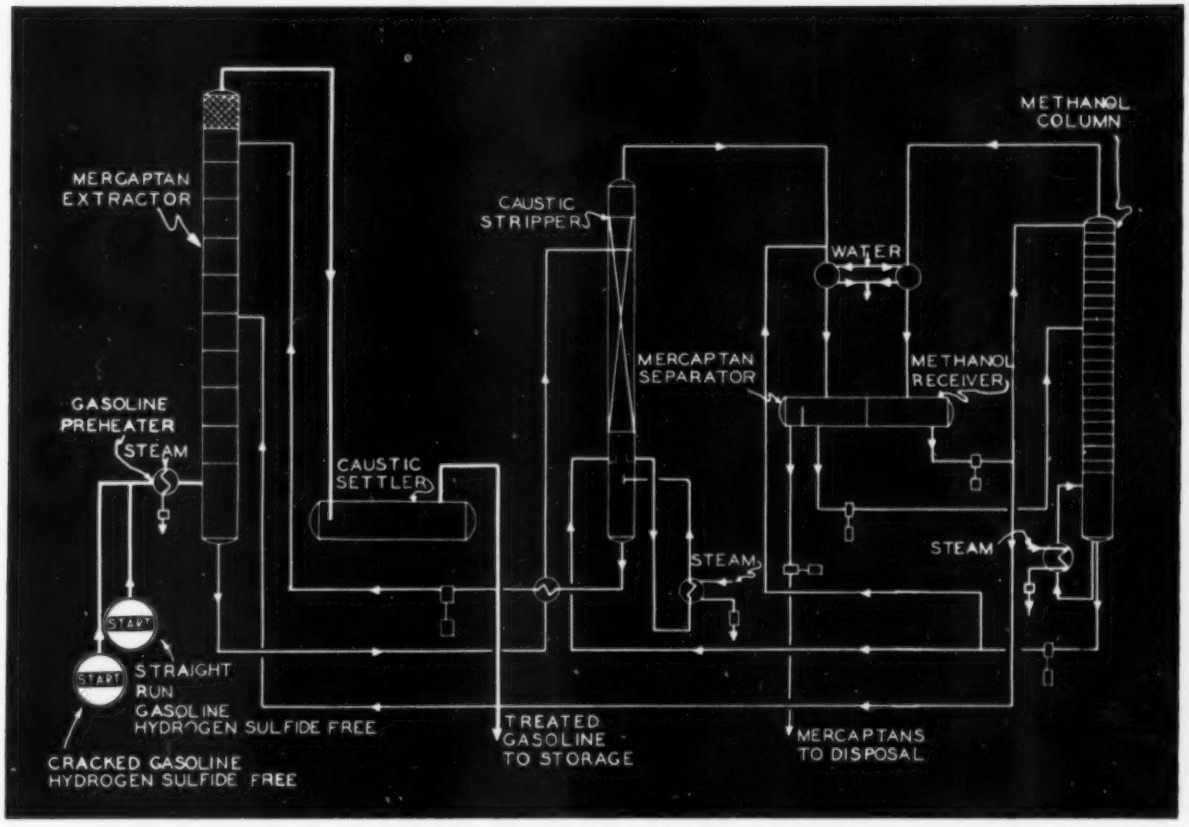
For mercaptan extraction the sour hydrocarbon feed is contacted with a suitable solutizer solution in countercurrent flow. The solution may contain as solutizer either added fatty acids or naturally occurring alkyl phenols. The latter may be used if their concentration in the fraction treated is great enough to maintain the required solutizer strength in the treating solution.

A typical extractor consists of mixer-settler stages; however, other suitable contacting equipment, such as towers having either Raschig-ring packing or perforated trays, have been used. The treated hydrocarbon flows from the extraction section to storage or subsequent operations.

The spent treating solution is heated to 130 to 160 F., passes through a gasoline coalescer, and enters the regenerator where the extracted mercaptans are oxidized to disulfides by air blowing. This operation is accomplished in a column equipped with efficient air dispersers or in any standard liquid-gas mixing device. The regenerated solution is passed through a coalescer to remove entrained disulfide oil, and dissolved disulfide oil is removed by a simple countercurrent or batch naphtha wash. The naphtha required is only 1 to 2 percent of the gasoline treating rate, and it may be disposed of by adding it to reforming or catalytic cracking charge stock. The regenerated solutizer solution is then cooled and returned to the extraction step.

The extracting agent is strong potassium hydroxide solution containing a small amount of tannin and mercaptan solubility promoters (solutizers) such as fatty acids; e.g., propionic and butyric acids, and/or alkyl phenols.

A simple and flexible design, quite readily adaptable to utilization of existing equipment, characterizes this process. No corrosion-resistant metals are required as operating temperatures are low and the treating solution is noncorrosive. Labor costs are low due to simplicity of operation and adaptability to virtually complete automatic control. The solution is inexpensive and has an extended treating life, so that chemical cost is nominal. Exhaust steam can be used to fulfill the limited heating requirements.



Unisol Mercaptan Extraction—UNIVERSAL OIL PRODUCTS COMPANY

Application—The process extracts mercaptan sulfur compounds from gasoline and higher boiling petroleum fractions.

Product—Mercaptan reduction of better than 99 percent is readily accomplished by the process. Octane number improvements at the 3 cc tetraethyl lead level range from one to three or more points on the commercial plants, depending on the mercaptan sulfur content of the untreated gasoline.

The treated product as it comes from the unit is usually sweet or nearly sweet. In almost all cases the product is completely sweet after a short time in storage, particularly if inhibited with UOP No. 5 Inhibitor, which has the unique property of accelerating air sweetening.

In comparisons of the properties of Unisol treated gasoline with the raw gasoline or with the product obtained by conventional sweetening, it is generally found that Unisol treating improves inhibitor susceptibility and lowers ASTM gum, and that copper-dish gums, after inhibiting, are considerably lower. Recently developed modifications enable the process to remove 95 percent or more of the mercaptans from distillates such as kerosine and domestic heating oil, thereby producing an oil with superior odor characteristics. Pyrrole-type nitrogen compounds are also removed by the process. Removal of sulfur and nitrogen compounds by Unisol treating markedly reduces color and sediment forming tendencies in distillate oils. Filter and burner tip plugging tendencies of domestic fuels, as determined by newly developed processes, are greatly reduced by Unisol treating.

Description—Hydrogen sulfide-free gasoline is introduced to the bottom of an extraction column and has mercaptans extracted from it as it flows upward in countercurrent contact with an aqueous solution of methanol and caustic soda. The caustic solution is introduced at the top of the extractor and methanol near the midpoint. Above the methanol inlet the caustic solution extracts any methanol dissolved by the gasoline from the caustic-methanol solution.

Treated gasoline is removed from the top of the extractor and sent to storage without any subsequent treating except addition of inhibitor. The fat caustic-methanol solution containing extracted mercaptans is withdrawn from the bottom of the extraction column and is charged to a caustic stripping column. In this column the methanol and mercaptans are stripped out leaving the caustic solution which is then withdrawn from the bottom of the column for re-use.

From the top of the stripping column, water-methanol-mercaptan vapors pass to a condenser. The condensed vapors then go to a mercaptan separator in which the extracted mercaptans separate from the water-methanol solution as an oily layer and are decanted from the system. The aqueous methanol solution is transferred from the mercaptan separator to a fractionating column from which methanol is recovered for re-use as an overhead product. Water from the bottom of this fractionating column is charged to the stripping column where it is evaporated to form stripping steam. There is no withdrawal of water from the system.

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INSTRUMENTS AND CONTROLS

For Power And Process

CONOCO

New installations recently placed in operation at Lake Charles, include units for crude oil distillation, catalytic cracker feed preparation, Thermofor catalytic cracking, gas recovery, catalytic polymerization, catalytic reformer feed preparation and aromatics extraction.

GREATER CAPACITY- EFFICIENCY- ECONOMY FOR CONOCO

For Continental Oil Company, Stone & Webster Engineering Corporation designed and constructed seven types of process units and enlarged an existing alkylation unit at the Company's Lake Charles, Louisiana, refinery.

Continuous flow through several of the units minimizes the need for intermediate offsite storage facilities; and all units are closely integrated for high heat economy.

These new units more than tripled the capacity of the refinery.

Write or call us for detailed information as to how our engineering, design, construction, report and appraisal services may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

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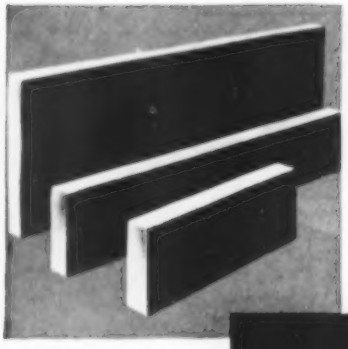
EAGLE-PICHER

Supertemp P-V Blocks



NEW STRENGTH AND LIGHT WEIGHT

for temperatures from

100 F. to 1900 F.

New light weight! Supertemp P-V Blocks are easily handled without breaking.

New strength of Supertemp P-V Blocks comes from a completely new manufacturing process developed by Eagle-Picher's research and engineering departments.

New light weight of Supertemp P-V Blocks results from the millions of "dead" air cells in Eagle-Picher's High Temperature Mineral Wool.

New strength plus extremely high thermal efficiency! Supertemp P-V Blocks are designed for continuous temperatures up to 1900 F. They're chemically and physically stable, too . . . ideal for heavy-duty insulating service.

New light weight makes P-V Blocks easy to handle—easy to apply—easy to cut for perfect fit. No special tools required.

And, of course, like all other Eagle-Picher insulation, Supertemp P-V Blocks soon pay for themselves in fuel savings and improved temperature control.

EAGLE-PICHER INSULSEAL PROTECTS! *Any insulation worth applying is worth protecting—and Insulseal provides a coating for insulation that dries to a flexible, hard, durable surface.*

Since 1843

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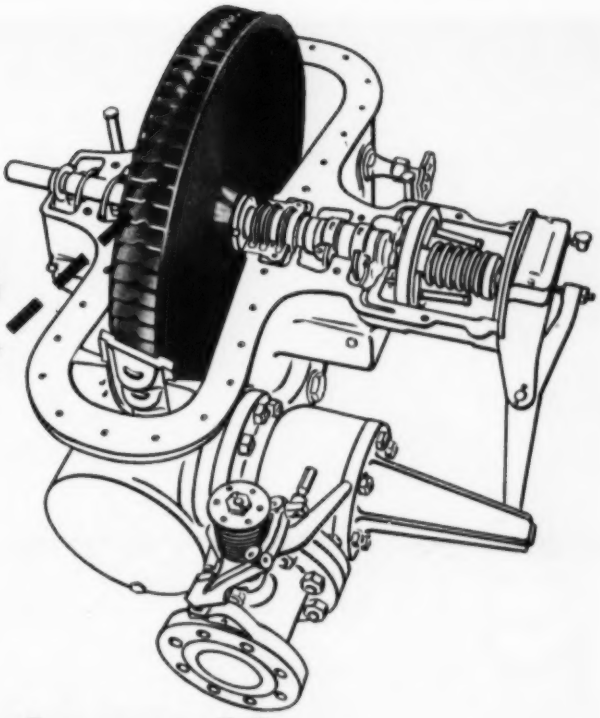
THE EAGLE-PICHER COMPANY

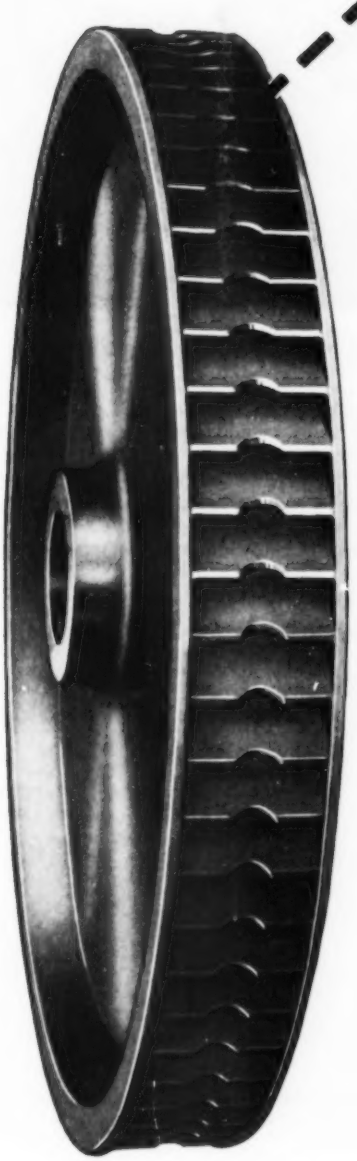
General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

Member of Industrial Mineral Fiber Institute

TERRY SOLID WHEEL





..."trade mark" of a trouble-free turbine

This is the rotor of a Terry solid-wheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semi-circular buckets is milled, there are no separate parts to become loose or work out.

Second, because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets, blade wear is of little consequence. Wear does not materially affect horsepower or efficiency.

Third, because the steam enters the buckets in a direction at right angles to the shaft, there is no need for close axial blade clearances. The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, the blades are double rim protected.

These are only a few of the reasons why the Terry solid wheel has become a "Trade Mark" for trouble-free turbine performance. For complete details, send for a copy of bulletin S-116. No cost or obligation.

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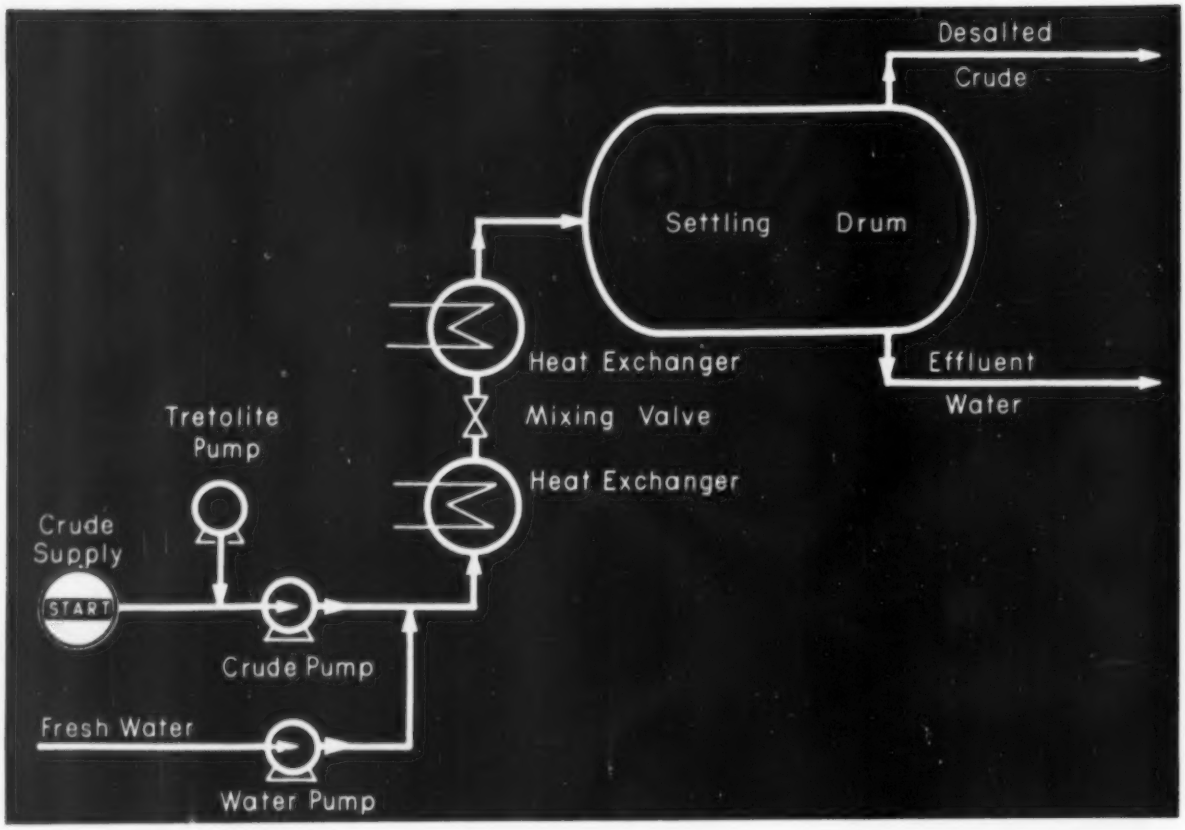
For more data on advertised products, use Readers' Service Cards, last page.



Chemical Desalting—TRETOLITE COMPANY

Application—Chemical desalting originally designed to remove inorganic salts from crude petroleum also provides for the removal of arsenic, trace metals and other objectionable contaminants.

Charge—Crude oils varying in gravity of from 15 to 50 API and exhibiting salt contents of from 15 to 600 pounds per thousand barrels are being efficiently desalted through properly designed Tretolite chemical units varying in size of from 1000 to 65,000 barrels per day per unit at an average chemical cost of less than 2.0 mills per barrel.

Products—Salt removal percentages for these various crudes average between 95 and 100 percent, with many installations continuously removing 99+ percent.

Description—Chemical desalting is accomplished by addition of fresh water and a desalting chemical to the salt-contaminated crude, mixing of these components to produce a non-stable synthetic water-in-old emulsion; and subsequent removal of water.

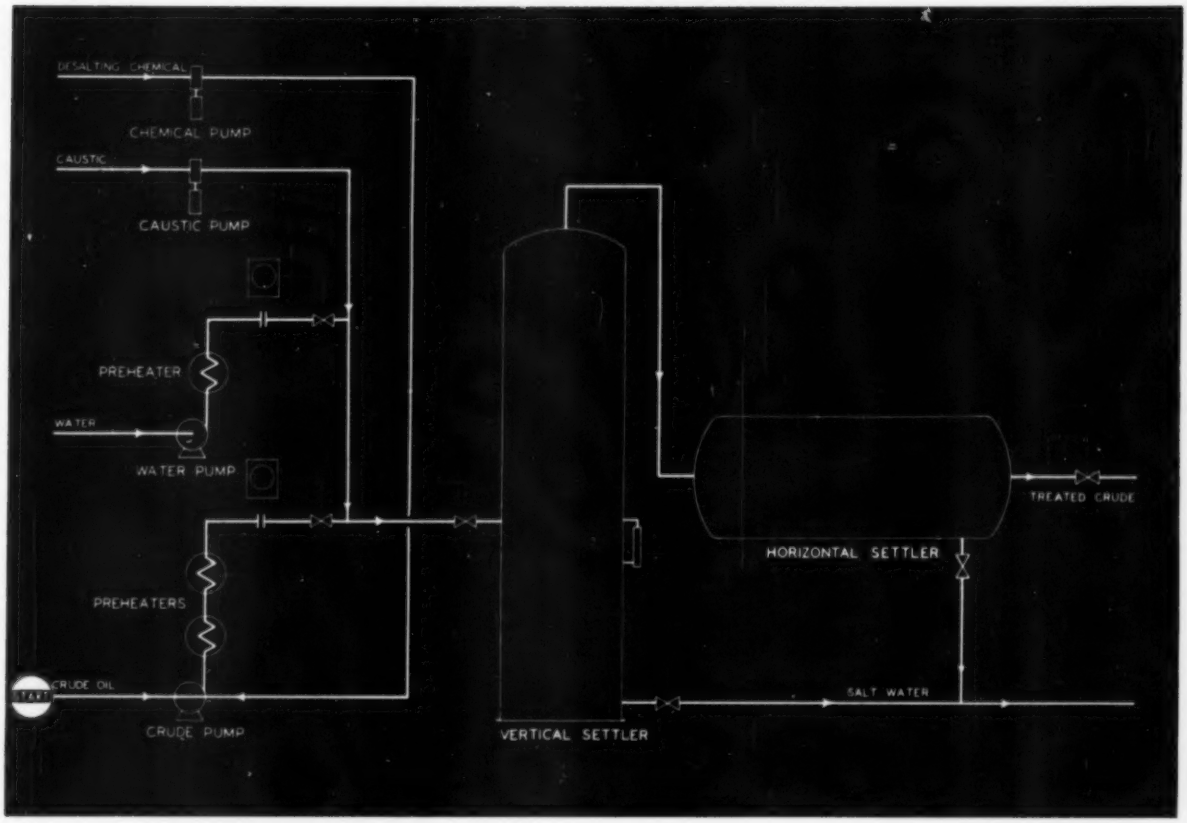
The process operates as follows: The required amount of Tretolite desalting chemical, determined by preliminary laboratory testing, is proportioned into the suction of the crude charge pump. This assures complete dispersion of chemical into the oil. Fresh wash-water, generally 5 percent of crude oil volume, is introduced following the charge pump. The mixture is then preheated and elevated to operating temperature. When additional water-to-oil contact is necessary for securing optimum desalting efficiency, an emulsifying valve may be located following one of the heat exchangers. The emulsion thus formed then passes through a "coalescing section," to promote particle growth in the water phase; then enters the desalting vessel, which provides adequate crude washing and oil residence time. Salt-free crude then flows directly to the still.

All crudes do not exhibit similar destabilization characteristics. Some are readily destabilized and the two liquid phases rapidly separate. Others require additional mechanical provisions to induce the separation and may also require longer oil residence time in the vessel. For these reasons units are designed to use either single or dual drum systems.

Yields—Topical operating conditions and yields:

Thru-Put Bbls./ Day	Type Crude	Per-cent Water	OPERATING		AVERAGE SALT CONTENT		Average Percent Removal	Chemical Cost/Bbl (Mills)
			Temp. °F.	Press. Psig.	In P.T.B.	Out P.T.B.		
5,000	East Texas	5	200	100	30	1.0	96.8	1.8
10,300	East Texas	5	260	180	30	1.0	96.8	2.0
12,000	Venezuela and Poza Rica	6	250	160	150	1.0	99.4	0.8
12,000	West Texas and Kansas	7	270	200	200	0.5	99.8	2.0
13,000	West Texas and Wyoming	4	290	165	80	3.0	96.4	1.0
14,000	Leduc and Mid-Continent	5	300	250	50	1.0	98.0	2.0
17,000	Coastal Mixed	5	200	225	35	0.2	99.5	1.0
20,000	Oklahoma Mixed	3	260	125	90	1.0	99.3	2.0
20,500	Redwater	6	220	180	75	2.0	97.5	2.0
24,000	Coastal Mixed	5	220	100	30	1.0	96.8	1.6
32,000	West Texas and Mid-Continent	3	280	165	135	5.0	96.4	1.0
36,000	Illinois	5	265	160	35	1.0	97.2	1.3
37,000	West Texas	3	300	295	30	0	100	0.4
45,000	West Texas	3	260	150	70	0.5	99.4	0.5
50,000	Mid-Continent	5	315	125	50	2.0	96.1	1.8
55,000	Kansas	6	265	275	90	0.7	99.4	2.0
58,000	West Texas	3	225	260	70	2.5	96.5	1.8

Commercial Installations—The Tretolite chemical process is in use for desalting more than 1.5 million barrels daily of refinery streams.



Chemical Desalting—VISCO PRODUCTS COMPANY, INC.

Application—The chemical desalting process is applied to crude oil at the refinery for the purpose of extracting the maximum amount of salt prior to processing. Salt, present as crystals suspended in the oil or dissolved in small amounts of water in the oil, will deposit in processing equipment and may drastically reduce thermal efficiencies and crude thruput, as well as contribute to serious corrosion damage.

Product—Visco desalting formulas are liquid material which can be generally described as complex organic condensation products which are synergized with modified alkyd type resins. They are soluble in oil and dispersible in water. A series of formulas is available to provide effective desalting of various types of crudes and under varying operating conditions. Compounds are offered for use with or without electrical desalting equipment.

Description of Process—A typical refinery installation for chemical desalting of crude oil is shown in the drawing. Two settling drums, heat exchangers, chemical pumps and a water pump, plus necessary valves and fittings, constitute the equipment recommended.

Chemical desalting is actually an extraction process which involves emulsifying the oil with fresh water by mechanical means, and then breaking the resulting artificial emulsion with heat and chemical. The salt preferentially dissolves in the aqueous phase and is drained off in the water following separation in settling drums.

To begin the process, the desalting chemical is added by means of a proportioning pump to the crude stream on the suction side of the crude charge pump. Chemical consumption varies, with one gallon treating from 1000-5000 barrels of oil, depending on the nature of the oil and the operating condition of the system. Preheated fresh water varying from 3 to 15 percent by volume may be added to the crude stream immediately after the charge pump before the heat exchangers, or may be added after the heat exchangers. Caustic is usually added to the fresh water to maintain a pH of seven or above in the brine removed at the completion of the process.

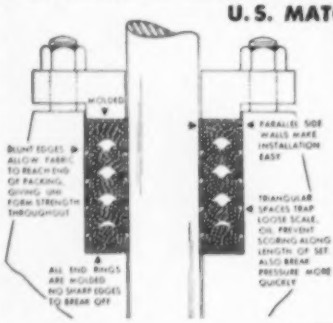
By mechanical means, such as a mixing valve, an emulsion of the water and oil is created. Since a demulsification step is to follow, no emulsifying agents are added, and the amount of mixing is based on the ease of subsequent breaking of the emulsion. The emulsion then flows on to a settling vessel where temperatures varying from 160-350 F are maintained. In this vessel most of the separation of water and oil takes place, and the salt water is drained off. In some cases a second settling drum is used to extend the settling time and to assure maximum separation of the salt water. The internal construction of the settling drums, as well as the level of the aqueous phase maintained, will vary considerably.

Desalted crude oil leaves the top of the settling drums, and salts dissolved in the water are withdrawn from the bottom. Total time involved is ordinarily 20-60 minutes.

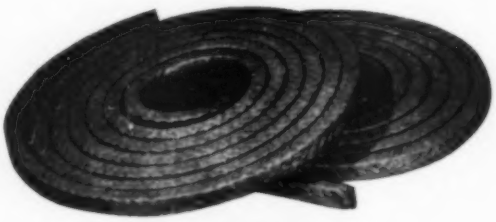
Yield—Chemical desalting can reduce salt content to the range of from 1 to 20 pounds per 1000 barrels, depending upon refinery limits for acceptable crude charge stock. About 90 percent salt removal is average, although upwards of 95 percent is not uncommon.

Key packings from the

U. S. MATCHLESS® PACKING


MOLDED
BLUNT EDGES ALLOW FABRIC TO REACH END OF PACKING, GIVING UNIFORM STRENGTH THROUGHOUT
PARALLEL SIDE WALLS MAKE INSTALLATION EASY
TRIANGULAR SPACES TRAP LOOSE SCALE, OIL PREVENT SCORING ALONG LENGTH OF SET. ALSO BREAK PRESSURE MORE QUICKLY
ALL END RINGS ARE MOLDED NO SHARP EDGES TO BREAK OFF

Style 16022. For hydraulic equipment, presses, rams, triplex pumps, outside packed pumps. This is the *high-pressure* packing—will withstand hydraulic pressure as high as 8000 pounds. Its self-adjusting automatic action results in reduced wear and tear on rods and plungers, minimizes friction.



U. S. CENTRIFUGAL PUMP PACKING

Style 193. For centrifugal pumps, or other rotating or oscillating rods or shafts, handling hot or cold, fresh or salt water, oil, brine, weak acids, caustic solutions and ammonia. High-grade asbestos, thoroughly lubricated and graphited, before braiding, by an exclusive "U. S." process.

U. S. SPECIAL REFINERY PACKING

Style 251. Recommended for reciprocating rods handling acid sludge and oils not over 400 degrees F. In coil form this packing makes an excellent filter press gasket. Made with a molded channel composed of layers of high-quality asbestos, frictioned together with a compound highly resistant to liquids encountered in refinery service.

U. S. BRAIDED CAUSTIC PACKING

Styles 126, 136. For reciprocating and centrifugal pump rods and valve stems handling light caustic and other corrosive solutions. Made from asbestos yarn, thoroughly treated with a special "U. S." caustic-resisting compound, and graphited. Style 126 is made in round cross-section. Style 136 is square cross-section.

U. S. RAINBESTOS HIGH-PRESSURE ROD AND PLUNGER PACKING

Style 101. For packing reciprocating or oscillating rods and plungers against high-pressure steam, air and gas up to 500 degrees F. Made from selected asbestos cloth, with a genuine U. S. Rainbow non-hardening cushion, formed square, and treated with heat-resisting lubricants and graphite.

U. S. GASOLINE PUMP PACKING

Style 413. Specially designed for service against cold gasoline, mineral oils and most solvents in service on centrifugal or reciprocating rods and valve stems.

U. S. Rubber Standardized Chart!

U. S. COMPRESSED ASBESTOS SHEET

Style 899. Recommended for packing flanges or joints against super-heated or saturated steam, air, ammonia, gases, oil, gasoline, water, some acids, alkaline solutions and other chemicals. This is the original oil-proof asbestos fibre high-pressure sheet developed specially for oil industry conditions. Will not soften, burn, blow or ooze out of a joint, and does not deteriorate with age in stock. When extreme resistance to oil is required, we recommend "U. S." style 19069.

U. S. OIL RESISTING DIAPHRAGM SHEET PACKING

In several styles, made from high-quality cotton fabric and nylon insertions with Neoprene cover stocks impervious to the action of cold oils and gasoline.

Style P-2901. Supersensitive sheet, 1/32" thick, 36" wide.

Style P-2138. Cotton sheeting insertion, in 36" width only, 1/32" thick and up.

Style P-2133. Medium wt. duck insertion, 46" wide, 1/16" thick and over.

Style P-2904. Nylon insertion in 40" widths, 1/16" thick and over.

"U. S." STANDARDIZED PACKING CHART FOR REFINERIES AND GASOLINE PLANTS

First "U. S." Packing Style Number Listed for Each Condition Is the Best Recommendation for that Particular Service

Service	Brine; Water, Cold	Water, Hot	Oil Distillates	Propane and Butane	Oil Up to 400° F.	Oil Over 400° F.	Ammonia	Caustic	Acid
Centrifugal	193	193	413	16193	193	512	193	Weak 136 Strong 293	293
Reciprocating Steam End	101	101	101	101	101	101	101	101	101
Fluid End	16010	16010	16012 251	16012 251 16133	16022 251	16022 512	133	16022 251	293
On Piston	463	453	575	575	...	...	...	...	...
Valve Stem	125	125	413	16193 16133	125	512	125	125	293
Gaskets	9	9	899	899	899	899	9	9	19069 899

Gaskets for:

Sweetland Press 8797

Tank Car Gaskets { Bolted Type ... 1771 / Screw Type ... 4773

These packings can fill 90% or more of your packing needs for the refinery. All standard sizes and dimensions are obtainable from your distributor's stock or "U. S. District Sales Offices. And for special problems, engineers at any of our 27 branches stand ready to provide packings to fill your requirements.

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"U.S." Production builds it
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Electric Treating—PETROLITE CORPORATION

Electric Desalting

Application—Pre-refining purification of crude oils.

Charge—Crude oil to be charged to refinery units.

Product—A purified charging crude, free from salts such as chlorides, sulfates and bicarbonates; solids such as sand, silt and rust; arsenic and other catalyst poisons.

Description—The crude charge to be purified is pumped to the desalter and a small quantity of fresh, hot water is mixed into the charge. The oil-water mixture is passed through an emulsifier which disperses the water into the crude, forming a water-in-oil emulsion. This emulsion is then projected into the high-potential electric field, where the salts, solids and other impurities are caused to be associated with the water phase by the coalescing action of the field. The water, now carrying the salts and other impurities, is rapidly separated from the crude. The purified crude continues on in the system as refinery charging stock.

Operating Conditions—Operating temperatures are in the 200-300 F. range. Operating pressures are in the 40 to 300 psi range.

Commercial Installations—The first Petreco Desalting process was installed in 1936. There are now more than 100 commercial electric desalting operations.

Electric Lube Oil Treating

Application—Automatically-controlled, continuous acid treating.

Charge—Lube distillates and similar stocks.

Product—Easily neutralized acid-treated lube stock.

Description—Acid is mixed into the stock to be treated by means of an acid injector. Rate of flow of stock and proportion of acid injected are automatically controlled, as are predetermined temperatures and pressures. The oil-acid mixture passes into mixing section, where acid is dispersed into the oil in the form of minute droplets. This mixed phase is passed into the precipitator, where the electric field causes rapid and efficient separation. The treated stock is withdrawn overhead for neutralization, while sludge is automatically drained from bottom of treater.

There is no set standard size for the precipitator vessel, as units of varying dimensions can be designed to meet treating requirements.

Operating Conditions—The principal operating variables are rate of flow of the stock to be treated, proportion of acid to be injected, temperatures and pressures. These are all automatically controlled within predetermined limits dictated by the treatment desired.

Yields—A typical electric treater, with a volumetric capacity of 90 barrels will yield approximately 2500 to 4000 barrels of acid-treated stock in one 24-hour day. The separation is highly efficient. Light stocks are virtually sludge-free, with only a minimum carry-over in heavier stocks. There is no loss of entrained lube distillate to sludge.

Commercial Installations—Four in operation, fifth under construction.

Electric Distillate Treating

Application—Acid, caustic, doctor, and other chemical refining where aqueous chemical solutions are dispersed into hydrocarbons.

Charge—Petroleum distillates such as gasoline, kerosine, diesel fuels, furnace oils, transformer oils and light lube distillates.

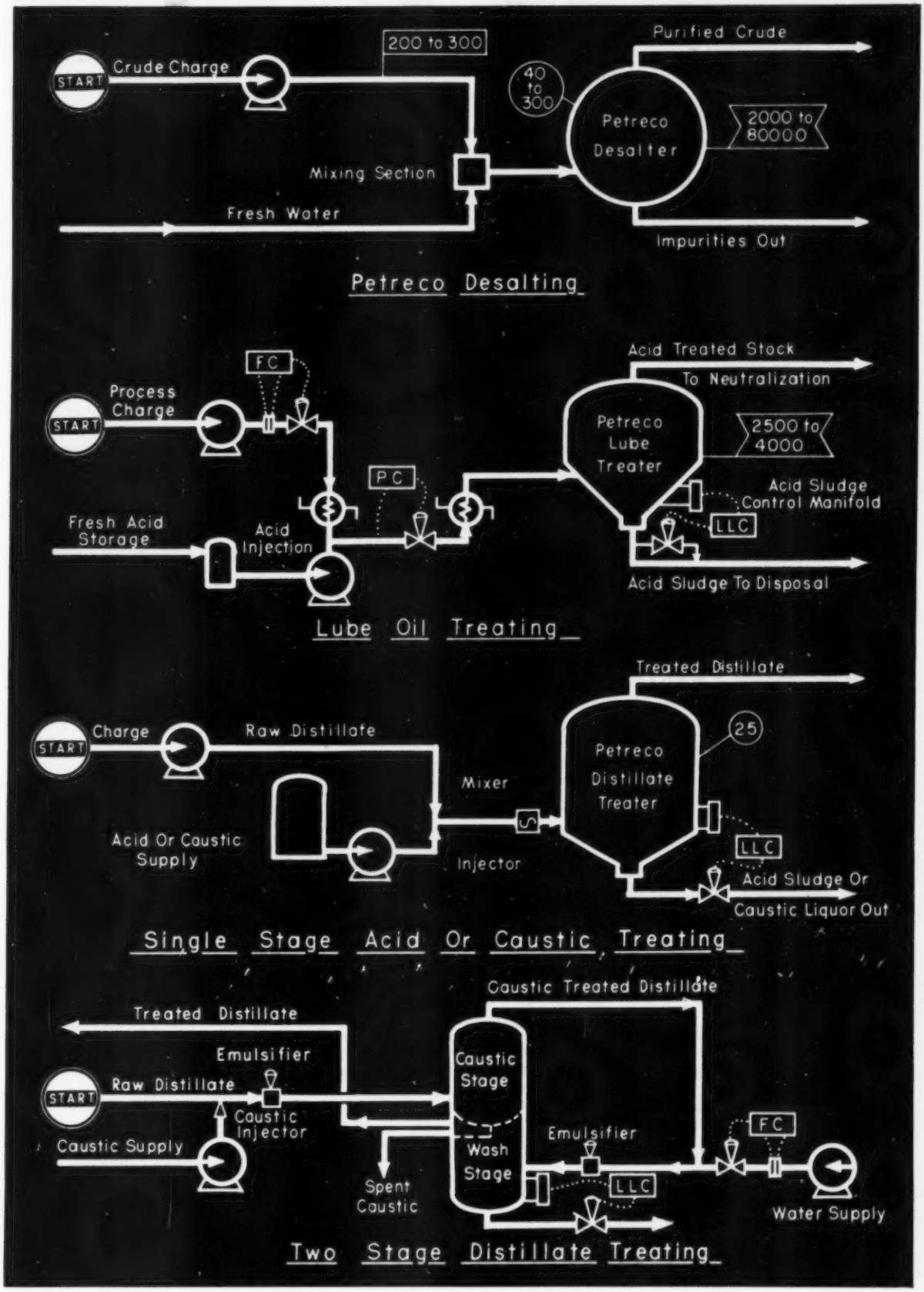
Product—Treated distillates, free from carry-over, ready for blending or shipping.

Description—Treating chemical such as acid, caustic or doctor solution is dispersed into the stock to be treated. Volume, degree of dispersion and time of contact are automatically controlled. The mixture is then subjected to the action of an electric field, which coalesces the dispersed phase and separates the acid sludge, spent caustic or doctor solution from the continuous phase.

The process has a wide variety of applications, with single-stage and two-stage equipment available. Any and all concentrations of caustic can be efficiently applied and separated. Acid treating, or acid/acid sludge treating in series can be accomplished. Doctor treating and two-stage treating incorporating a water wash are other alternatives. The flow diagrams illustrate the broad applications possible.

Operating Conditions—The process operates at the normal temperatures at which the stock to be treated comes from run-down tanks or storage. A pressure of 25 psi or less, is required to hold the distillates in a liquid phase. A power demand of 5 kw is adequate for electric treating, at the usual power voltage of 460 volts, 60 cycles.

Commercial Installations—Six.


START
Crude Charge
200 to 300
40 to 300
Purified Crude
Petreco Desalter
2000 to 80000
Mixing Section
Fresh Water
Impurities Out
Petreco Desalting
FC
Process Charge
START
PC
Acid Treated Stock
To Neutralization
Petreco Lube Treater
2500 to 4000
Acid Sludge Control Manifold
LLC
Fresh Acid Storage
Acid Injection
Acid Sludge To Disposal
Lube Oil Treating
Treated Distillate
START
Charge
Raw Distillate
Mixer
Petreco Distillate Treater
25
Acid Or Caustic Supply
Injector
LLC
Acid Sludge Or Caustic Liquor Out
Single Stage Acid Or Caustic Treating
Caustic Treated Distillate
Treated Distillate
Emulsifier
START
Raw Distillate
Caustic Stage
Caustic Injector
Caustic Supply
Wash Stage
Emulsifier
FC
Spent Caustic
LLC
Water Supply
Two Stage Distillate Treating

Composite photo of one torch and jet mixer with three different welding tips: 13, 7 and 1.
two new reasons
why the AIRCO 800 is the...
MOST VERSATILE TORCH YOU CAN BUY
2. NEW JET MIXER
1. NEW CUTTING ATTACHMENT

The Airco Style 800 torch will handle any welding, heating or cutting job, thanks to the brand new Airco Jet Mixer and two completely redesigned cutting attachments.

The new Jet Mixer gives you perfectly stable flame control with all gas flows. Cyclonic action swirls the gases together, mixing them completely, within a tip size range from 0 to 14 inclusive. Rubber gas sealing rings provide a gastight seal with hand tightening, no wrench required . . . saves time in tip changes.

New heavy-duty cutting attachment takes all standard tips; cuts steel up to 8" thick! Medium-duty attachment available for lighter service. Both have rubber gas sealing rings, plus mixers which can be easily removed for cleaning, if necessary.

Owners of Style 800 torches can use the new Jet Mixer and cutting attachments with their present torches. For details, write to Air Reduction or see your Airco dealer, asking for your copy of Catalog 818, "Hand torches for gas welding and cutting."

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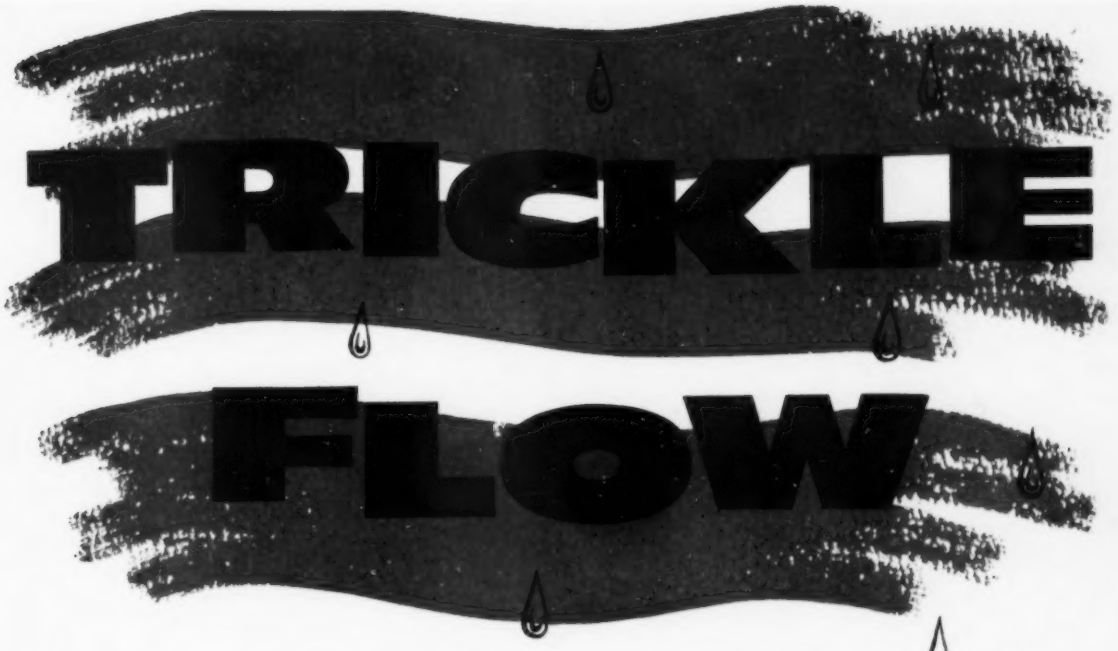

the new way to remove sulfur

SHELL HYDRODESULFURIZATION PROCESS

WITH by-product catalytic reformer hydrogen available, you should look into this new Shell **Trickle Flow** Process.

Trickle Flow operation makes this process unique and economically attractive for hydrofining distillates because of:

- **Very low hydrogen recycle**
- **Sustained catalyst activity**
- **High liquid yields**
- **No need for re-running products**

The Shell **Trickle Flow** Process employs a rugged, low-cost sulf-active catalyst.

A large commercial plant, using Shell **Trickle Flow** Process, is now approaching completion and several others are being planned.

We invite your inquiries.

SHELL

SHELL DEVELOPMENT COMPANY

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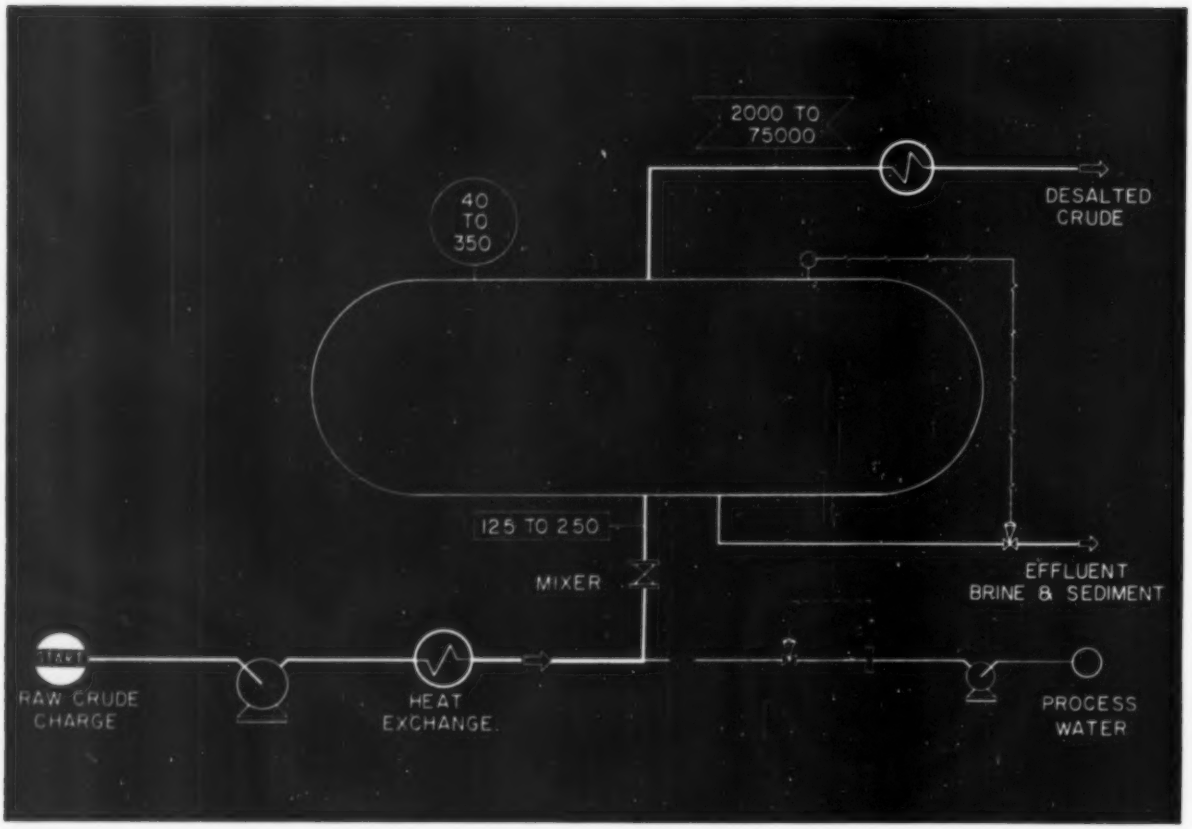
For more data on advertised products, use Readers' Service Cards, last page.



Electrical Desalting—HOWE-BAKER CORPORATION

Application—Howe-Baker desalters are installed in the refinery raw crude charge line to remove salts and other impurities.

Charge—Crude oil.

Description of Process—The process consists of adding fresh water to the raw crude in the amount of 4 to 8 percent by volume to dissolve and adsorb the impurities to be removed. The process water is thoroughly mixed in the crude to form a stable emulsion. The water-in-oil emulsion is introduced into a high potential electrical field in the desalter vessel where the dispersed water droplets are agglomerated and allowed to accumulate in the lower portion of the drum. The brine water, and various impurities contained therein, is continuously discharged to the sewer system. The clean desalted crude continues to the refinery flow circuit.

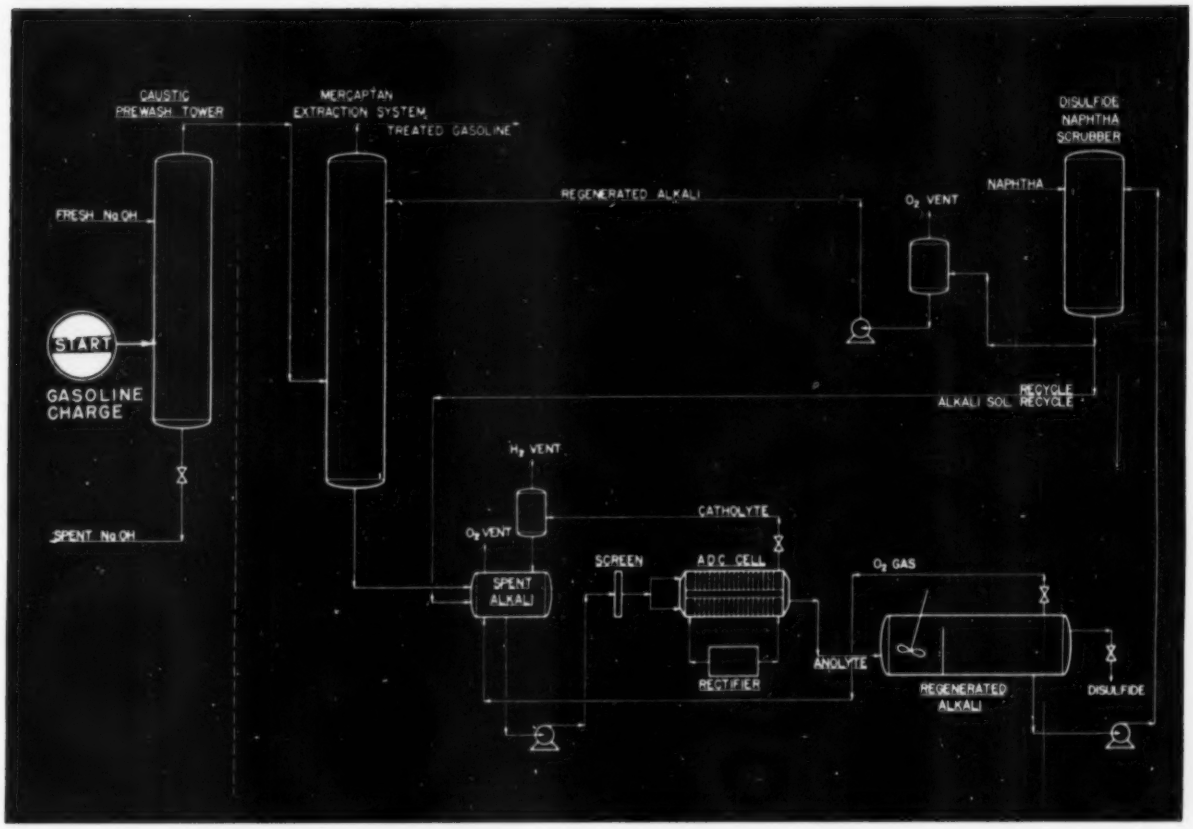
Wherever possible, accessory equipment and controls are items of standard manufacture that may be furnished to the purchaser's specifications.

Salts in oil are most generally contained in the residual water of the crude oil. These residual water droplets are usually highly stabilized and may vary from practically fresh water to saturated brines. The chemical composition of the salts found in these brines varies widely but sodium chloride is the one most universally found with the chlorides of calcium and magnesium usually being present in smaller amounts. In addition to the chlorides, all crude oils contain as mechanical suspensions certain solid materials such as silt, iron oxides, silica or quartz sand, crystalline salt, carbon and sulfur. Since many of these suspended impurities will be carried in or on the residual water globules, a great proportion of them will be removed during the desalting process

Operating Conditions—Depending on the characteristics of the crude being treated, temperatures required at the desalters will be in a range of 125 to 250 F. A minimum operating pressure of 40 psi is required. Higher operating pressures do not affect the process and the upper limits may be established by design requirements of other elements in the flow circuits. Several plants have been installed for operating in a range of 325 to 350 psi. Savings in installation costs may be realized by using higher pressure designs in order to eliminate surge vessels and booster pumps after the desalter.

Commercial Installations—A partial list of Howe-Baker installations is as follows:

Company	Capacity Design BPD
Atlantic Refining Company	50,000
California Oil Company	30,000
Esso-Standard Oil Company	235,000
Humble Oil & Refining Company	280,000
Imperial Oil Company, Ltd.	65,000
Pure Oil Company	104,000
Petroleos Mexicanos	40,000
Socony-Vacuum Oil Company	66,000
Sinclair Refining Company	315,000
Standard Oil Company of Texas	25,000
Sun Oil Company	15,000
Foreign Plants	85,000
Under Construction—	
General Petroleum Company	40,000
Petroleos Mexicanos	50,000
Shell Oil Company	52,000



Electrolytic Mercaptan—AMERICAN DEVELOPMENT CORPORATION

Application—The process reduces the mercaptan content of hydrocarbon streams to improve odor and lead susceptibility.

Charge—Any hydrocarbon mixture in which the mercaptan content is objectionable.

Description—The stock is given a preliminary caustic wash if it contains, in addition to mercaptans, other acidic substances such as H_2S and acid oils. The pre-treated gasoline is then contacted in a continuous counter-current extraction system with an aqueous alkaline solution capable of extracting mercaptans. The mercaptan-rich alkaline solution flows into the spent alkali surge drum where it is mixed with a part of the regenerated solution and oxygen gas, and then pumped through a fine screen to the electrolytic cell.

The main stream of the spent alkali flows through the anode compartments and a slip stream through the cathode compartments of the cell. In the anode compartments part of the electric current converts dissolved mercaptans to disulfides and the remainder generates gaseous oxygen. The gaseous oxygen leaves the cell along with the anolyte and is then immediately mixed in a turbo-mixer or similar device to convert additional mercaptans to disulfides. The dispersed mixture of alkali and oxygen is permitted to settle. Three phases form—gaseous oxygen, disulfides and regenerated caustic.

The unabsorbed oxygen is contacted with the contents of the spent alkali drum before venting to achieve some mercaptan oxidation prior to the entry of the solution into the electrolytic cell. The disulfides being substantially insoluble in the alkaline solution form an upper layer in regenerated alkali settler and are periodically drawn off.

The regenerated caustic leaving the settler is given a simple naphtha wash to prevent any disulfides from entering the gasoline. Part of the regenerated solution leaving the naphtha scrubber is recycled to the spent alkaline tank; the remainder is pumped to the extraction system for further service.

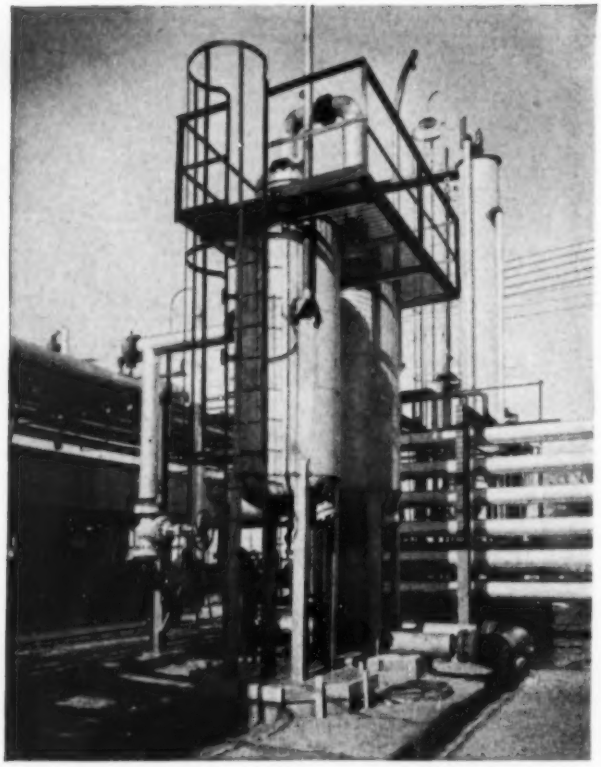
The hydrogen formed in the cathode compartments of the cell is vented, the catholyte being recycled to the spent alkali drum.

Other than the ADC electrolytic cell which is of filter press type construction with permeable diaphragms between adjoining plates, and the conventional type of rectifier, the process employs ordinary refinery equipment. Corrosion is at a minimum since the process normally operates at ambient temperatures and neither heating nor cooling is necessary.

The extractant may be any aqueous solution capable of extracting mercaptans from hydrocarbons and possessing reasonable conductivity. NaOH or KOH solutions are generally used. With adequate pretreatment, no chemicals are consumed in the regenerative cycle.

Commercial Installations—The first unit was installed at Ashland, Ky., during 1951. Capacity—5000 barrels per day. Additional units have been installed at Raffineries Francaises de Petrol de L'Atlantique, Donges, France—capacity 6500 barrels per day; Leonard Refineries, Alma, Mich.—5000 barrels per day; Sun Oil Company, Sarnia, Ontario—2000 barrels per day; Arabian American Oil Company, Ras Tanura, Saudi Arabia—25,000 barrels per day.

INTERESTED IN UNIFINING* FOR DESULFURIZATION AND UPGRADING



• First Commercial Unifining Unit
United Refining Co.
Warren, Pennsylvania

UNIFINING should be of particular interest to all operators of catalytic reformers which produce by-product hydrogen.

• Harshaw is the exclusive producer of the Union Oil Company of California cobalt-molybdate catalyst used in the recently announced "Unifining" desulfurization and upgrading process. This rugged, commercially proven catalyst is supplied in the form of cylindrical tablets conforming to rigid physical and chemical specifications established by Harshaw and Union Oil Company of California. Stability at high temperatures permits repeated regenerations if and when necessary.

Please contact Harshaw for further information on this catalyst.

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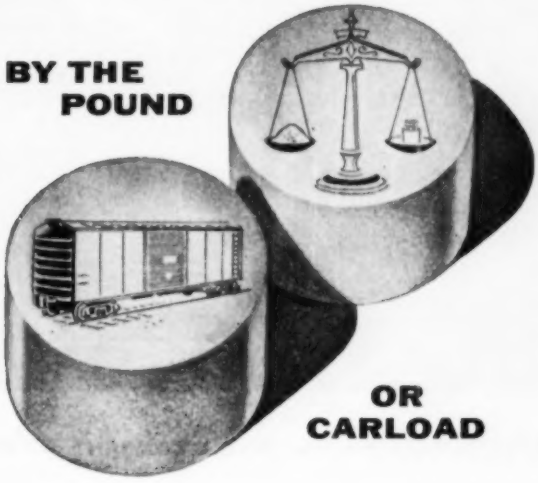

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Harshaw has facilities for producing your catalysts in any quantity, whether measured in pounds or tons. If you are in the experimental or development stage and need only a few pounds of your catalyst, call for Harshaw's technical assistance; if you are in the production stage, call on us to produce any amount of catalyst you need. Your specifications will be met . . . exactly. And Harshaw's ability to produce will provide the catalyst . . . when you want it. If your mind's on catalysts, call Harshaw today.

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HARSHAW CATALYSTS AVAILABLE IN 7 FORMS:

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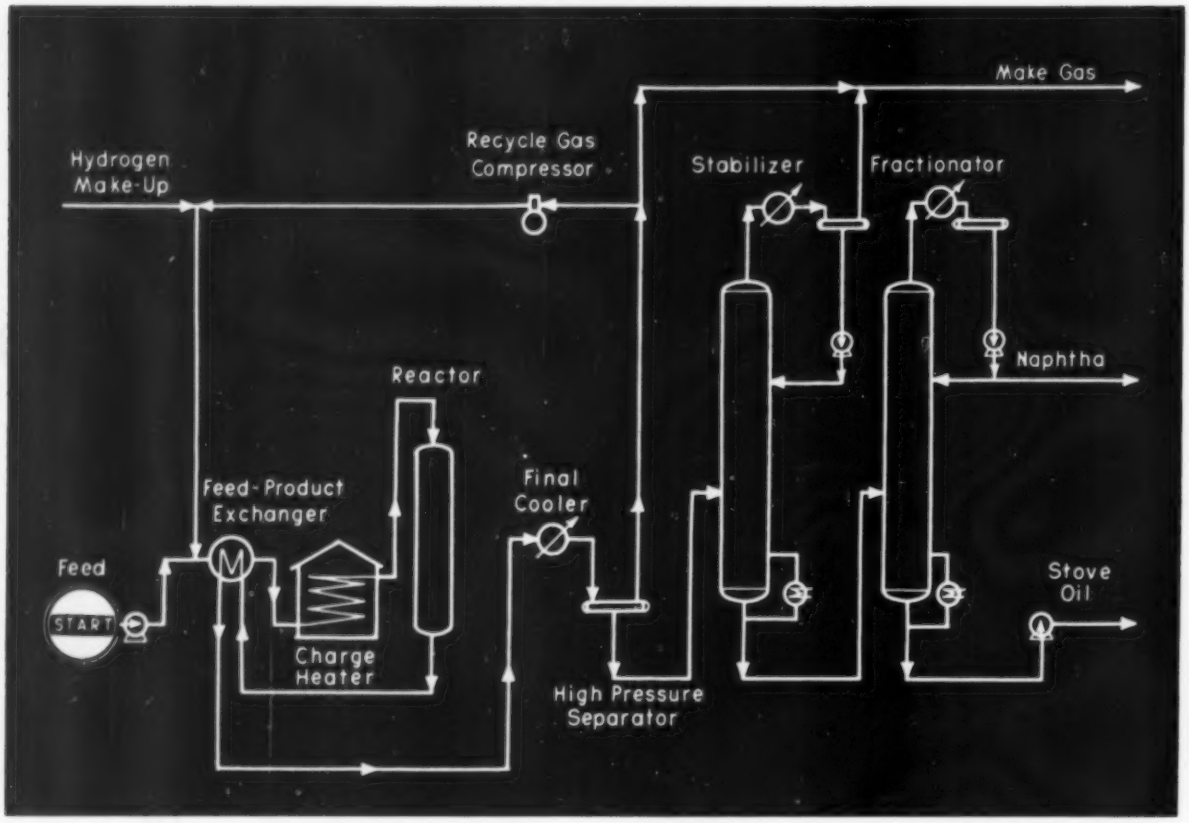


Unifining— UNION OIL COMPANY OF CALIFORNIA

Application—Unifining is a versatile means of removing sulfur, nitrogen, oxygen and metal contaminants from petroleum distillates. In addition, an improvement in the characteristics of these stocks is realized.

Charge—The process may be applied to fractions of wide boiling ranges—from gasolines to heavy vacuum distillates—either straight run or cracked, of high sulfur content or low.

Product—The process accomplishes these product improvements:

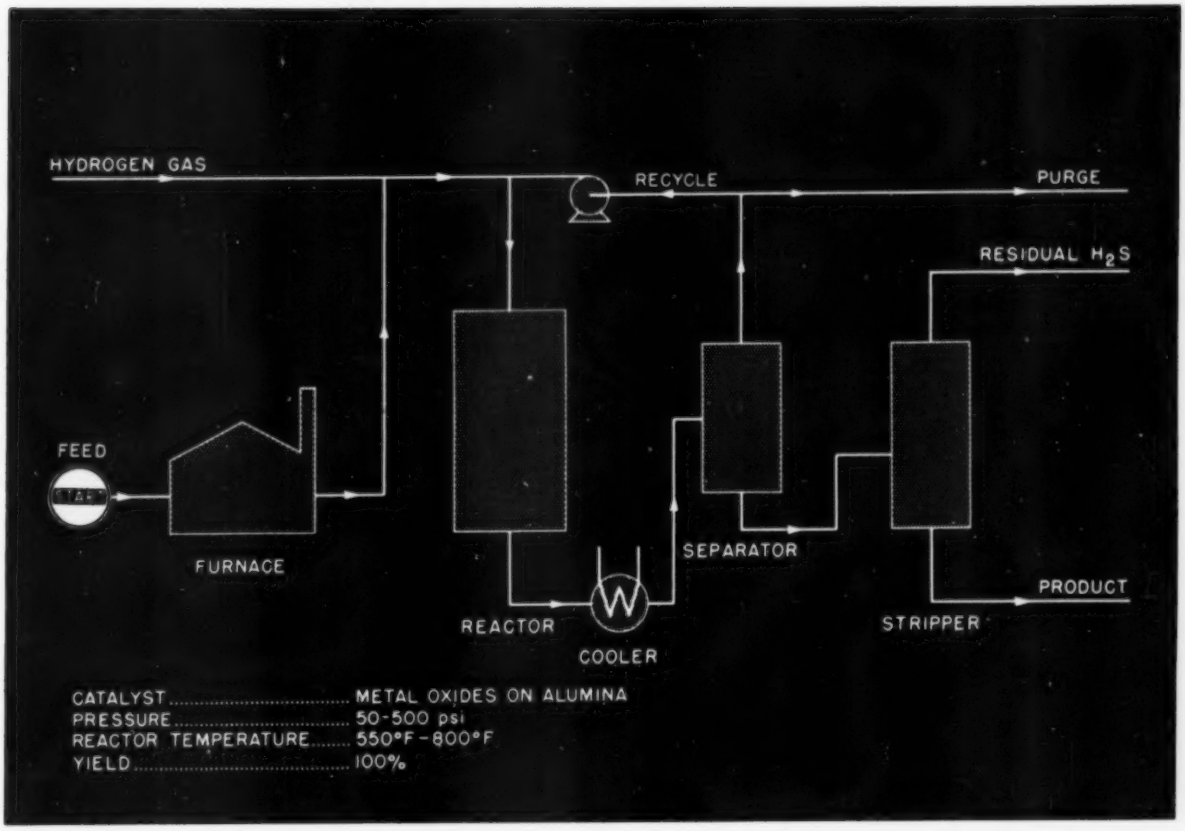
1. Improvement in odor and color stability.
2. Pretreatment of catalytic reformer charge stocks.
3. Reduction in sulfur and nitrogen compounds.
4. Improvement in burning properties, cetane number and susceptibility to catalytic cracking.

Description—The accompanying diagram shows an equipment arrangement for the simultaneous preparation of catalytic reformer feed and high grade stove oil by the processing of coker distillates. The feed is combined with hydrogen recycle gas, preheated by heat exchange with reactor products, and heated to the required reactor inlet temperatures. On passing through the reactor, the desired catalytic reactions are accomplished and depending on the specific application, these may occur in either vapor phase or mixed phase conditions. The reactor products, after heat exchange, are cooled and flow to a high pressure separator. The hydrogen rich gas is recycled back to the reactor; any excess over process requirements being vented to fuel. The high pressure separator liquid flows to a stabilizer for removal of dissolved light gases and is shown in this figure as a conventional refluxed stabilizer. In other specific applications this stabilizer may be replaced by a stripper, rectified absorber, or other comparable equipment. The stabilized product is then ready for fractionation as indicated in this flow diagram, or may be utilized directly.

Yields—Typical results are indicated below when Unifining a mixture of high sulfur heavy naphthas and when Unifining a diesel oil.

	California Mixed Thermal and Straight Run Heavy Naphtha		Wyoming Diesel Oil	
	Charge	Product	Charge	Product
Gravity, °API	46.1	51.1	31.3	34.8
ASTM Distillation, °F.				
Initial	221	196	452	260
10 Percent	257	249	523	492
50 Percent	313	310	560	547
90 Percent	390	385	603	596
Max.	440	446	640	644
Sulfur, Weight Percent	1.9	0.008	2.1	0.14
Bromine Number	20	<1	....	....
Nitrogen, ppm.	130	10	....	....
Cetane Number	....	....	46	52
Liquid Yield, Volume Percent charge	....	101	....	100

Commercial Installations—The first commercial installation was made in 1953. At the present time some ten units are in the process of design and construction. A license to use the Unifining process may be procured through either the Commercial Development Division of Union Oil Company of California or Universal Oil Products Company.



Hydrofining—STANDARD OIL DEVELOPMENT COMPANY

Application—Hydrofining is a versatile hydrogenation process which may be used for sulfur removal and general upgrading of a wide variety of products from gasolines to waxes.

Charge—Feed stocks for commercial units, either operating or planned, include such materials as gas oils, heating oils, cracked naphthas, virgin naphthas, lube stocks and waxes.

Product—Product quality, for the variety of stocks which can be treated, will vary with the degree of treatment used in this flexible process. In treating fuels—a popular application of the process—Hydrofining will successfully lower sulfur content, reduce odor, prevent formation of gummy deposits and carbon residues, and generally correct those properties which might tend to foul engines and oil burners. Product yield is 100 percent on the oil feed.

Description—The oil feed enters a coil furnace, where it is heated to a temperature, usually between 550 and 800 F. It then passes to a fixed bed reactor vessel together with the fresh hydrogen gas. In the reactor, the feed is treated in the presence of the hydrogen and a regenerable metal oxide catalyst at pressures usually between 50 to 500 psi. After leaving the reactor, the product is cooled before entering a separator from which hydrogen-rich gas is recirculated back to the reactor in amounts varying according to the specific requirements of the finishing operation. After separation, the product stream enters a stripper where any residual hydrogen sulfide gas is removed.

Hydrofining fits uniquely into the present trend toward higher octane gasolines. The reforming processes being used extensively to produce high octane fuels also are producing large quantities of by-product hydrogen. This hydrogen can be used to supply the Hydrofiner, and many refineries are installing Hydrofining along with catalytic reforming as a modern quality improvement combination. In some cases, not only will the hydrogen required for Hydrofining come from a reformer, but also the feed stock for certain fixed-bed reforming units will be pretreated in the Hydrofiner.

Commercial Installations—Five units, with a total capacity of 28,000 barrels per day, are in operation—three in the U. S. and two in England. Fourteen additional units are either under construction or planned. Combined capacity of the 19 units will be 155,000 barrels daily.

COMPANY*	Refinery Location	Status	Design Feed Rate B/SD
Esso Standard Oil Co.	Bayonne, N.J.	Operating	2,500
Esso Standard Oil Co.	Linden, N.J.	Under Construction	7,640
Esso Standard Oil Co.	Linden, N.J.	Under Construction	19,520
Esso Standard Oil Co.	Baton Rouge, La.	Planned	26,200
Esso Standard Oil Co.	Baton Rouge, La.	Planned	12,740
Esso Standard Oil Co.	Baltimore	Under Construction	12,000
Esso Standard Oil Co.	Baltimore	Under Construction	3,000
Esso Standard Oil Co.	Baltimore	Under Construction	5,000
Esso Standard Oil Co.	Everett, Mass.	Planned	2,400
Esso Standard Oil Co.	Everett, Mass.	Planned	2,250
Humble Oil & Ref. Co.	Baytown, Texas	Operating	20,000
Humble Oil & Ref. Co.	Baytown, Texas	Planned	4,850
Humble Oil & Ref. Co.	Baytown, Texas	Planned	12,000
Imperial Oil Ltd.	Sarnia, Canada	Operating	600
Imperial Oil Ltd.	Edmonton, Canada	Under Construction	2,000
Esso Petroleum Ltd.	Fawley, England	Operating	3,705
Esso Petroleum Ltd.	Fawley, England	Operating	1,583
Esso A. G.	Hamburg, Germany	Planned	8,450
Esso Standard, S.A.F.	Port Jerome, France	Planned	8,450

* All are affiliates of Standard Oil (New Jersey)

Johns-Manville announces the development of new **SIL-O-CEL 16L** *Insulating Fire Brick . . .*

Lompoc, California, where Johns-Manville mines and processes diatomaceous silica insulating materials

Combines outstanding physical and thermal properties for furnace service to 1600F

Check these properties of SIL-O-CEL 16L

Maximum service temperature	1600F, back-up or exposed
Approximate density	33-35 lb per cu ft
Transverse strength	60 psi
Cold crushing strength	350 psi
Linear shrinkage	0.7 percent at 1600F
Reversible thermal expansion	less than 0.1 percent at 1600F
Thermal conductivity (Btu in. per sq ft per F per hr at indicated mean temperatures)	0.92 at 500F 1.07 at 1000F 1.22 at 1500F

1—has less than 0.1% reversible thermal expansion at 1600F

2—provides high load-bearing strength

3—for direct exposure or back-up service

Here is a new development of Johns-Manville insulation and refractory research. Its exceptional characteristics provide important savings in furnace construction. Made of diatomaceous silica, Sil-O-Cel* 16L Insulating Brick is light in weight . . . has low thermal conductivity . . . high structural strength. And where furnace linings are subjected to severe heat shock or where high load-bearing properties are needed, Sil-O-Cel 16L offers outstanding performance

Sil-O-Cel 16L is now available. Samples will be sent on request. Also available without obligation is Booklet IN-115A, which describes Sil-O-Cel 16L and other J-M Insulating Brick and Insulating Fire Brick for service to 3000F. Write Johns-Manville, Box 60, New York 16, N.Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

*Sil-O-Cel is a Johns-Manville registered trade mark

Replaces SIL-O-CEL Natural Brick

The development of Sil-O-Cel 16L Insulating Brick has resulted in the discontinuance of Sil-O-Cel Natural Brick. The outstanding properties of Sil-O-Cel 16L make it the ideal replacement for Sil-O-Cel Natural Brick for back-up use. In addition, the properties of Sil-O-Cel 16L Brick extend its use to exposed service applications.

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Johns-Manville *FIRST IN* INSULATION

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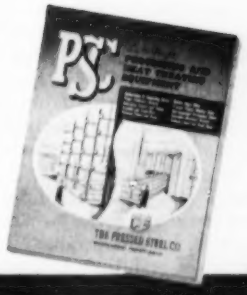
As a leading supplier of bubble caps, PSC not only offers a wealth of production know-how but also substantial economies. With dies on hand for 300 standard styles, PSC is saving many customers the cost of dies, as well as design and delivery time. Special caps to order. Some customers have effected maintenance economies with PSC units because we fabricate from any metal which will best meet their specific requirements: aluminum, brass, copper, nickel, carbon steel, any chrome or chrome-nickel stainless. For engineering data on the 300 standard styles SEND FOR CATALOG 54.



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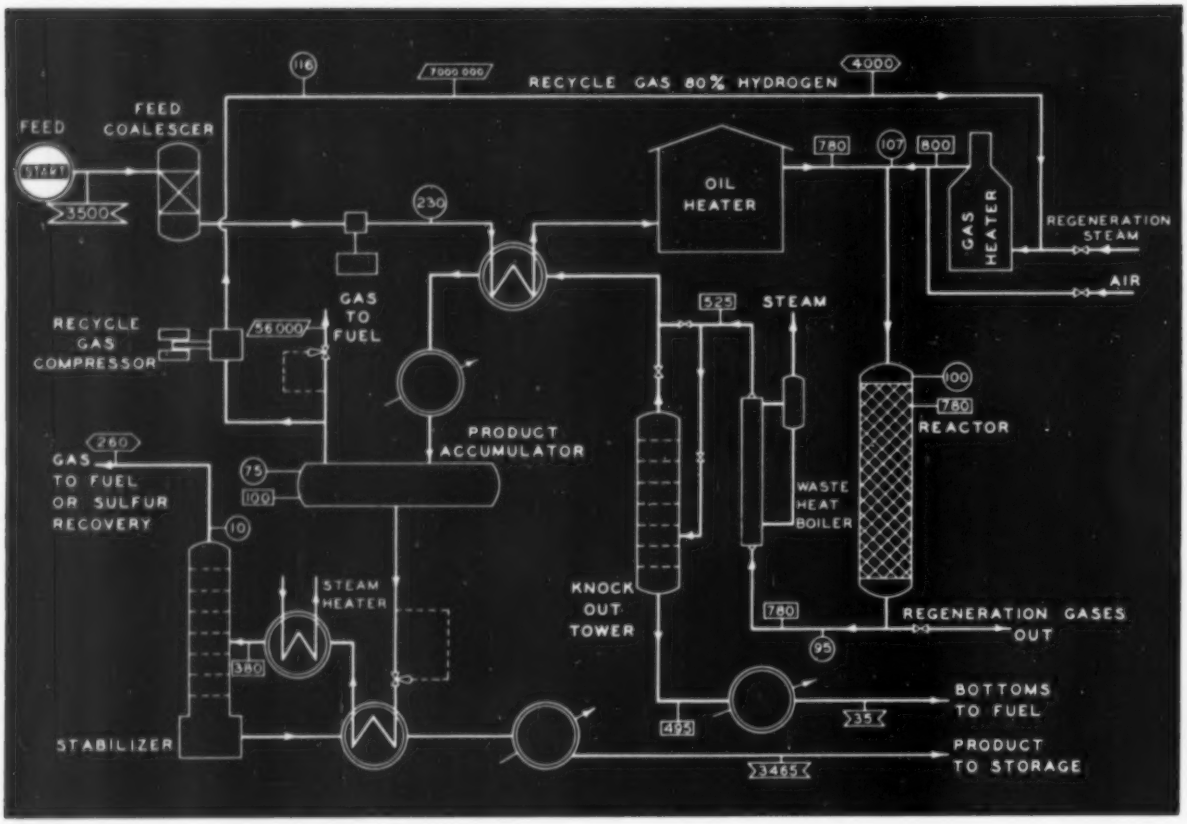


Autofining—ANGLO-IRANIAN OIL COMPANY, LTD.

Application—Autofining is a catalytic process for the desulfurization of high sulfur distillate feedstock which does not require an external source of hydrogen.

Charge—Straight run distillates up to 700 F. end point also aromatic extracts and blends with cracked distillates.

Product—With almost complete desulfurization the light products show an increase of 2-4 octane numbers (clear) and a greatly increased lead response. Under appropriate conditions 90 percent desulfurization can be obtained with straight run gas oil feedstocks.

Description—The accompanying flow diagram is that of an Autofining unit designed to handle solvent naphthas and power kerosines. The feedstock and the recycle gases are vaporized and heated in separate heaters and pass downward through the reactor. The hot vapors from the reactor pass through a waste heat boiler, where steam is generated; after heat exchange and cooling, the products flow to the separator from which the recycle compressor takes suction. If it is desired to meet a color specification with products such as power kerosines, the products leaving the waste heat boiler pass into the knock out tower where 1 to 2 percent volume of heavy ends are removed. Any excess gas make is passed to fuel from the product separator. Liquid product from the separator passes to a flash tower stabilizer to remove the hydrogen sulfide and other gases, which results in flash point rectification. The stabilizer product is normally free of hydrogen sulfide but a light caustic soda wash may be advisable to guard against poor stabilizer operation.

Granular (2 to 4 mesh) or pelleted catalyst is used and a life of over two years has been obtained. Regeneration of the catalyst can be readily accomplished by air/steam or inert gas/air mixtures when the full activity of the catalyst can be restored.

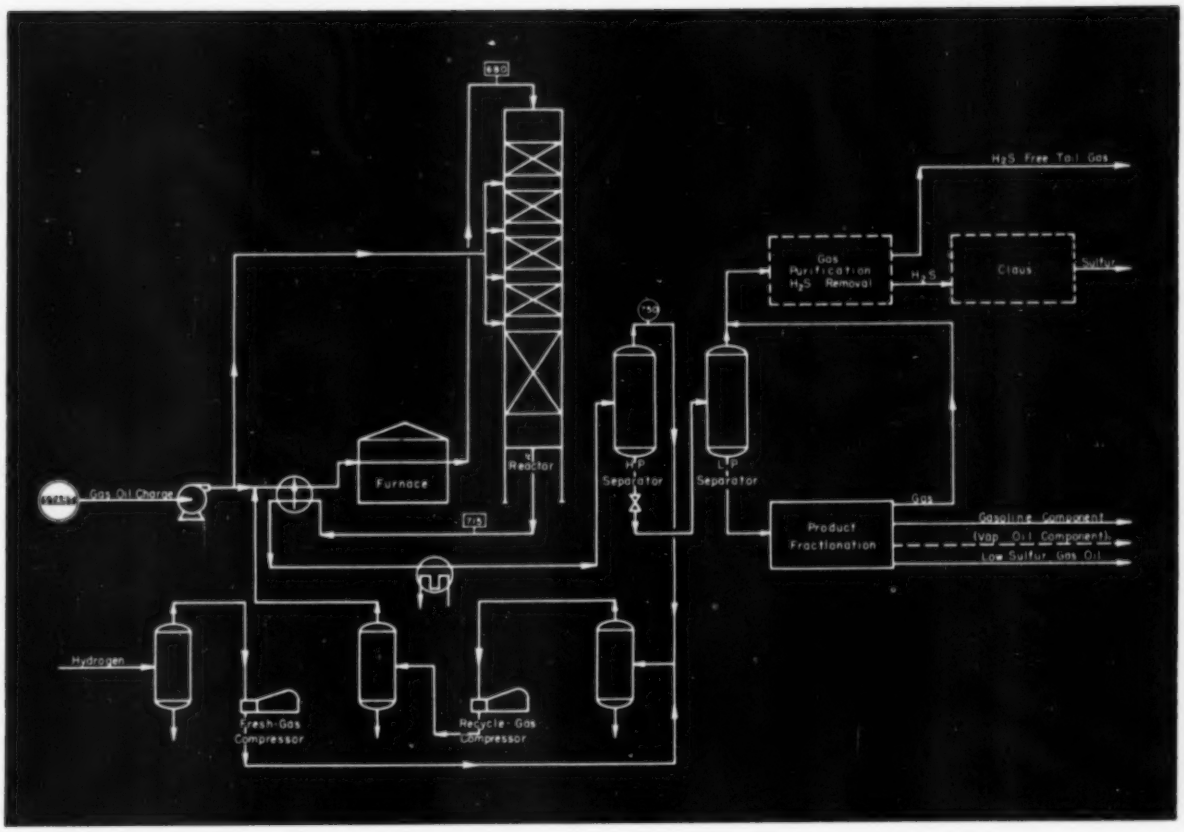
Operating Conditions—The process variables are temperature, pressure, space velocity and gas recycle rate; the most important being the space velocity. The usual operating temperature range 750-800 F. Pressures may be held at 100-200 psig by venting excess recycle gas, or allowed to reach equilibrium in the system when the pressure may rise to 600 psig.

Yields—Typical yields and properties when operating on Middle East feedstock are shown in the table below.

	Power Kerosine*		Straight Run Gas Oil	
Method of Operation	Constant Pressure (100 psig.)		Equilibrium Pressure (500 psig.)	
Yield:				
(Weight Percent on Feed)	99.0		96.0†	
Sulfur Removal Percent	70.0		92.0	
	Feed	Product	Feed	Product
°A.P.I. at 60 F	39.6	40.2	36.3	38.0
I.B.P., F	284	291	482	360
E.P., F	502	500	684	671
Percent Sulfur	0.8	0.24	1.25	0.1
Octane Rating (F2) Clear	52	53		
Diesel Index			60	60

† 1.4 Percent Weight Light Ends not Included. * Inclucing 10 Percent Cat. Cracked Component.

Commercial Installations—The initial plant built in 1948 at the Grangemouth, Scotland, refinery has been increased to a 500-barrel-a-day unit, and a second unit is in operation at Llandarcy, Wales. A further unit has been completed at AIOC's Aden refinery.



Shell Hydrodesulfurization—SHELL DEVELOPMENT COMPANY

Application—The process is used to remove sulfur from middle distillates by means of the reaction of sulfur compounds with a minimum amount of hydrogen.

Charge—Middle distillates such as straight-run and catalytically-cracked gas oils.

Product—A sulfur removal of 85 to 90 percent is obtained, a small fraction of high-octane gasoline being produced from the sulfur compounds.

Description—As shown in the diagram, the oil charge and fresh hydrogen, as well as recycle hydrogen, are combined. The combination is first preheated by exchange with hot reaction products, and then is heated in a small gas- or oil-fired furnace.

The reactor may contain a number of catalyst beds between which cold charge oil is injected to take up the heat produced in the exothermic hydrogenation reactions. The number of beds required depends upon the sulfur and olefin content of the charge stock and upon the degree of sulfur removal desired. With low-sulfur stocks, i.e., stocks with a sulfur content of, say, approximately 1 percent by weight or less, intermediate cooling may be omitted. The reaction products, after heat exchange with the feed, are cooled further and then passed to the high-pressure separator—from which, after the addition of makeup hydrogen, the gas is recycled. The liquid from the high-pressure separator is flashed in a low-pressure separator, and is then passed to a product fractionating section for removal of the remaining hydrogen sulfide and light ends.

If desired, an engine-fuel type of kerosine component may be recovered. The low-pressure tail gas may be passed to a gas-purification plant for removal of hydrogen sulfide, which may subsequently be converted to sulfur in a Claus plant.

For most commercial applications the rate of decrease of catalyst activity will be extremely low, corresponding to a catalyst life of the order of one year.

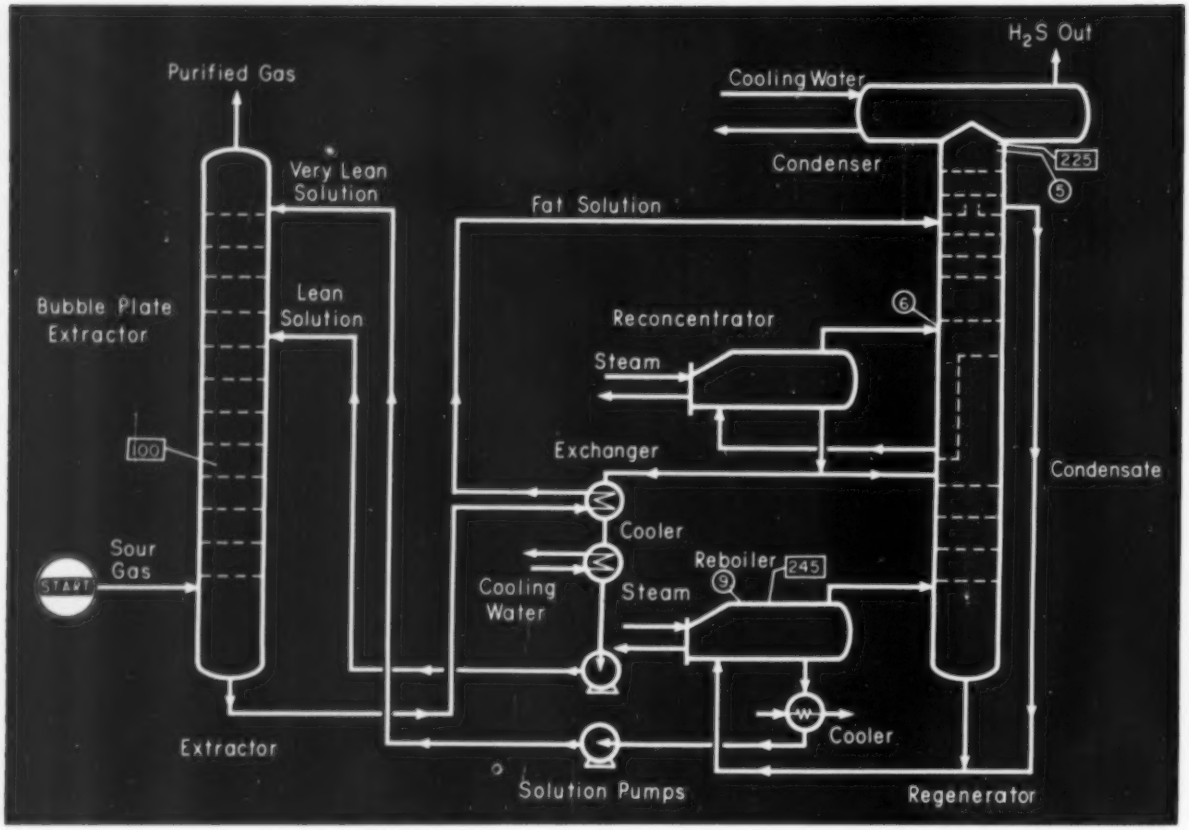
Operating Conditions—The preferred operating conditions for deep desulfurization of middle distillates (80 to 90 percent sulfur removal) are 750 to 850 psia and 680 to 730 F.

Yields—The table below shows typical product properties for the hydrodesulfurization of a Middle East light catalytically cracked gas oil:

Processing Conditions:	
Catalyst	Cobalt-molybdenum-alumina
Pressure, psia	750
Temperature, Fahrenheit	710
Liquid Hourly Space Velocity, Vol. per Vol. per Hour	1.6
Recycle-Gas Rate, scf per Barrel	1350

	Feed Stock	Product* Under 430 F	Product* 430 to 500 F	Product* 430 F Plus	Product* 500 F Plus
Percent Weight of Feed	100	9.9	20.3	87.6	67.3
Percent by Volume of Feed	100	10.7	21.3	90.4	69.1
Gravity, Deg. API	21.3	33.8	25.4	26.1	25.5
ASTM Distillation (Fahrenheit)					
Initial Boiling Point	446	270	437	475	532
End Point	650	417	480	650	650
Sulfur, Percent by Weight	2.90	0.01	0.02	0.34	0.43
Extractable with 98 Percent Sulfuric Acid, perc. by Wt.	70	87	80	.....	.....
Octane Numbers:					
ASTM, Without TEL Addition	.....	90	77	.....	.....
CFR Research, Without TEL Addition	.....	100+	88	.....	.....
Pour Point, Fahrenheit	14	.....	.....	19	25
Diesel Index	19.5	.....	.....	27.1	29.9

* Sharp Fractionation.



Phosphate Desulfurization—SHELL DEVELOPMENT COMPANY

Application—The Shell Phosphate process is a continuous cyclic process for removing and recovering hydrogen sulfide from natural and refinery gases and liquid hydrocarbon fractions. The process consists of two steps: absorption and regeneration.

Description—The principal absorption reaction may be expressed by the equation:

$$K_3PO_4 + H_2S = K_2HPO_4 + KHS$$

Regeneration of the solution is effected by means of stripping steam, which reverses the absorption reaction.

Treatment of gas and liquid streams differs only in the design of the extractor and, generally, in the use of split-solution flow for gas treating. The sketch shows the split-solution flow scheme.

Under actual operating conditions the tripotassium phosphate solution used in the process removes H_2S preferentially from gases containing both H_2S and CO_2. This unique feature of the Phosphate Process may be highly advantageous in desulfurization of natural or synthesis gases. In such cases it is often unnecessary or undesirable to remove most of the CO_2 along with H_2S for reasons besides the higher attendant stripping steam consumption.

The Phosphate process is particularly suitable for recovery of H_2S from which it is desired to make elemental sulfur. For that purpose it is important that the recovered H_2S be of high purity, i.e., with minimum CO_2 and hydrocarbon content. The Phosphate process can remove H_2S economically from gases containing CO_2 and H_2S in ratios as high as 20 to 1.

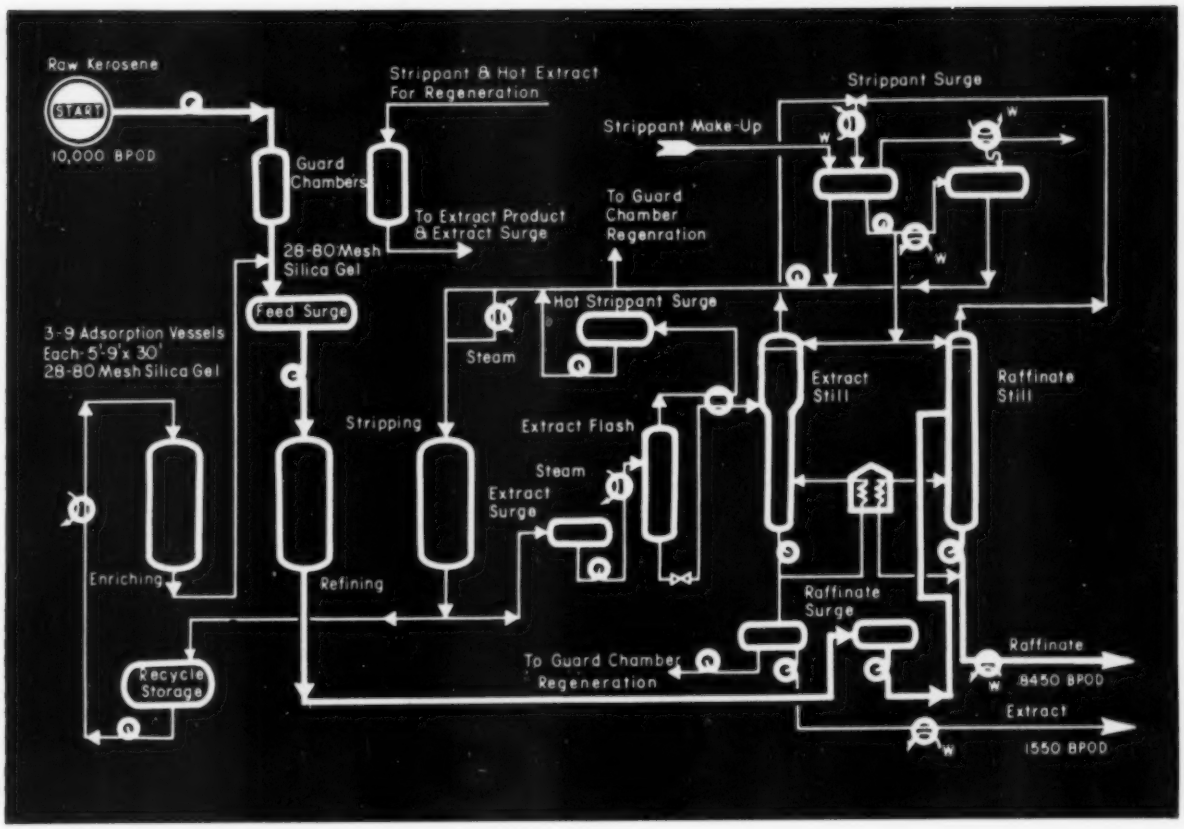
In treating gases, the extraction step is carried out in a bubble-tray column using split-solution flow. The raw gas is contacted countercurrently with the lean solution in the lower section of the column for removal of the bulk of the H_2S; as it proceeds through the upper part of the column, the gas is further contacted with the very lean solution to achieve the final degree of H_2S removal required.

In the treatment of liquid hydrocarbon streams, the extraction step is achieved with countercurrent single-solution flow. After extraction, the liquid hydrocarbon flows through a solution coalescer which serves to safeguard against solution loss through entrainment.

The hydrogen sulfide recovered by this process is essentially free of hydrocarbons and is an ideal raw material for manufacture of sulfuric acid or elemental sulfur.

Since K_3PO_4 is a stable inorganic salt which does not decompose nor vaporize under treating conditions, it does not contaminate nor polymerize the hydrocarbons and the solution loss is negligible. Iron and steel are satisfactory for all equipment. If the cooling water is corrosive, admiralty-metal tubes and Muntz metal sheets and baffles may be used in the condenser and solution coolers. Gages, instruments, valves, and pumps should be all iron and steel. Observance of these general specifications will insure freedom from corrosion on the process side.

Commercial Installations—Forty plants have been installed.



Cyclic Adsorption Refining—CALIFORNIA RESEARCH CORPORATION

Application—The process may be used to (1) recover concentrated aromatic fractions from catalytic reformates, or (2) dearomatize a paraffinic solvent.

Charge—The charge may be any cut from which it is desired to recover or remove aromatics with boiling points anywhere from 100 up to 500 F. or higher. The feed should be essentially free from significant amounts of polar compounds, including water, and of diolefins.

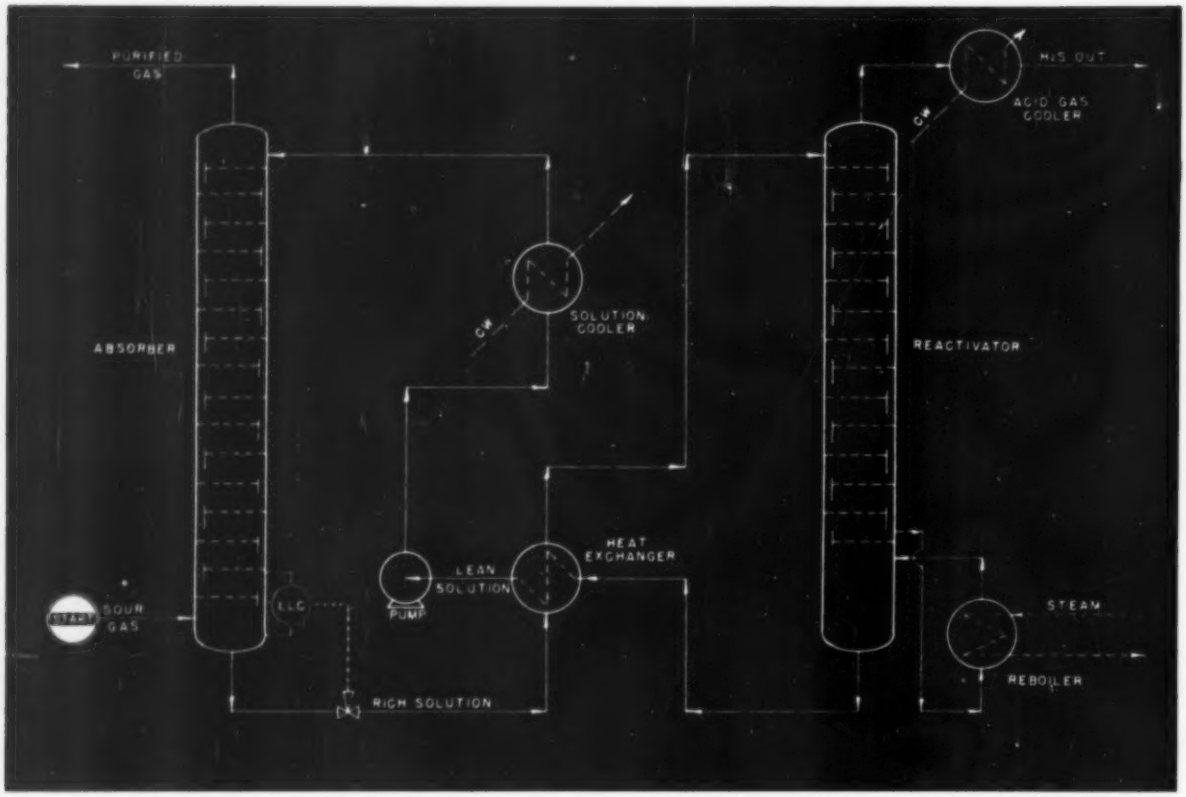
Product—High purity aromatic concentrates and/or low aromatic content paraffinic solvents.

Description—In the refining zones aromatics are selectively adsorbed by the gel, yielding a refined raffinate of the desired low aromatic content. As each case has adsorbed its capacity of aromatics from the feed, it is switched to the enriching zone where it is treated with a recycle stream higher in aromatics than the feed to complete the displacement of paraffinic hydrocarbons from the adsorbed phase. High purity aromatic product is recovered by hot stripping of the gel after enrichment. Both raffinate and extract are separated by distillation from the strippant. The strippant used may be any paraffinic stock whose boiling range differs from that of the feed. The adsorbent used is generally a silica gel specially selected to perform the particular separation desired. Selection of the gell will depend upon the boiling range and aromatic content of the feed and the characteristics of the end products desired. Gel lives of 8000 hours are obtainable with proper feed stocks. Strippant consumption is very low, being only the small amounts not separated from extract and raffinate in the distillation steps. The flow diagram illustrates the dearomatization of a kerosene fraction.

Operating Conditions—The adsorption steps, both refining and enriching, operate at 80-100 F. The stripping cycle employs temperatures of around 350 F. The highest temperature in the plant is generally that of the distillation tower kettles, and the highest pressure is normally that required to pump feed through the adsorption towers, generally not over 100 psig.

Yields—The yield or degree of recovery of aromatics from the feed depends upon the number of stages and the quantity of gel employed in the refining zone. Similarly, the degree of purity of the extract is governed by the number of stages and quantity of gel employed in the enriching zone.

Commercial Installations—No commercial plant has been installed to date. Process licenses are available from California Research Corporation.



Girbotol—THE GIRDLER COMPANY

Application—The process is employed for removal and recovery of hydrogen sulfide from natural and refinery gases, for desulfurization and dehydration of natural gas, for purification of liquid hydrocarbons, and for separation of carbon dioxide from hydrogen and synthesis gases.

Description—The Girbotol process originated with the discovery that acidic gases such as hydrogen sulfide and carbon dioxide react with certain amines to form compounds which may be broken down by heat. This reversible reaction may, in the case of hydrogen sulfide, be represented as follows:

$$RNH_2 + H_2S = RNH_3HS \text{ (where R represents an organic radical)}$$

The equilibrium proceeds to the right or left, depending on the temperature, and on the partial pressure of the hydrogen sulfide. The solutions generally employed are aqueous solutions of ethanolamines, mono-(MEA), di-(DEA) or tri-(TEA).

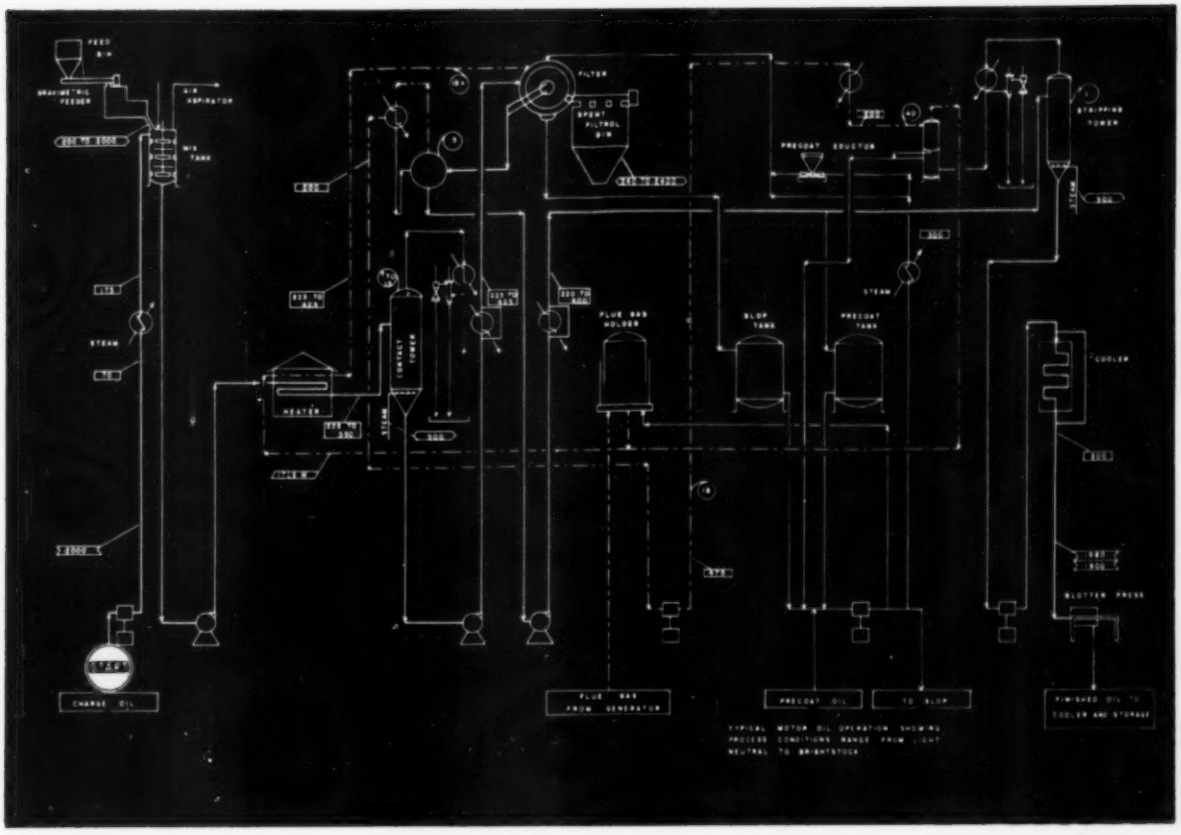
The operation is a continuous process in which the solution passes through the absorber where hydrogen sulfide is removed from the gas, through a heat exchanger and into the reactivator. In the reactivator hydrogen sulfide is stripped from the rich solution by heat and passes out of the tower as a concentrated gas together with some steam into the acid gas cooler. The stream is condensed in this cooler and returned to the cycle while the hydrogen sulfide may be flared, burned under a boiler or recovered as elemental sulfur.

The lean solution, essentially free from acid gases, passes from the bottom of the reactivator through the other side of the heat exchanger, a circulating pump, a solution cooler and back to the absorber. The positions of the solution pump or pumps will vary in individual cases depending on the pressure of the treated gases. The case shown is typical for high pressure natural gas operation. If the gas pressure is not sufficient to return the solution to the reactivator, an additional pump is required for the rich solution. The absorber and reactivator towers may be either packed or bubble plate towers of conventional design.

Another type of Girbotol process is in use for purifying liquid hydrocarbons in a similar manner. A packed or sieve plate tower is used for the absorber and either the liquid hydrocarbon or the Girbotol solution maintained in a continuous phase depending on the specific case.

Operating Conditions—The choice of the proper amine and solution strength depends on the composition of the gas to be treated, the percentage of hydrogen sulfide and/or carbon dioxide in the gas and the final purity desired. In many cases it is possible to attain a moderate degree of selectivity by the proper choice of solutions and operating conditions where complete hydrogen sulfide removal is desired and carbon dioxide removal is not required. The solution circulation rate of a Girbotol plant depends on the above factors as well as on the quantity, temperature and pressure of the gas to be treated. If the gas mixture is at its hydrocarbon dewpoint, the treating temperature should be maintained 10 to 20 F. above the inlet gas temperature to prevent the condensation of hydrocarbons in the treating equipment. Girbotol plants are customarily designed to purify gases at their full line pressure and the pressure drop through the equipment ordinarily will not exceed 5 to 10 psi.

Commercial Installations—Several hundred are in operation.



Continuous Contact Filtration—FILTROL CORPORATION

Application—The principal application for this process is the refining of lubricating oil stocks, but it is also applied successfully to the finishing of waxes and specialty oils.

Charge—Petroleum hydrocarbons in the lubricating oil or specialty oil range that have been solvent extracted, acid treated or simply distilled. Solvent extracted stocks are dewaxed, usually, before charging.

Product—Finished lube oil or specialty oil base stocks ready for blending and compounding.

Description—The flow diagram shows the operating conditions (minimum and maximum) for a hypothetical unit processing motor oil base stocks ranging in viscosity from light neutrals to bright stocks at an average rate of 2000 barrels per day. Larger and smaller feed rates are employed also.

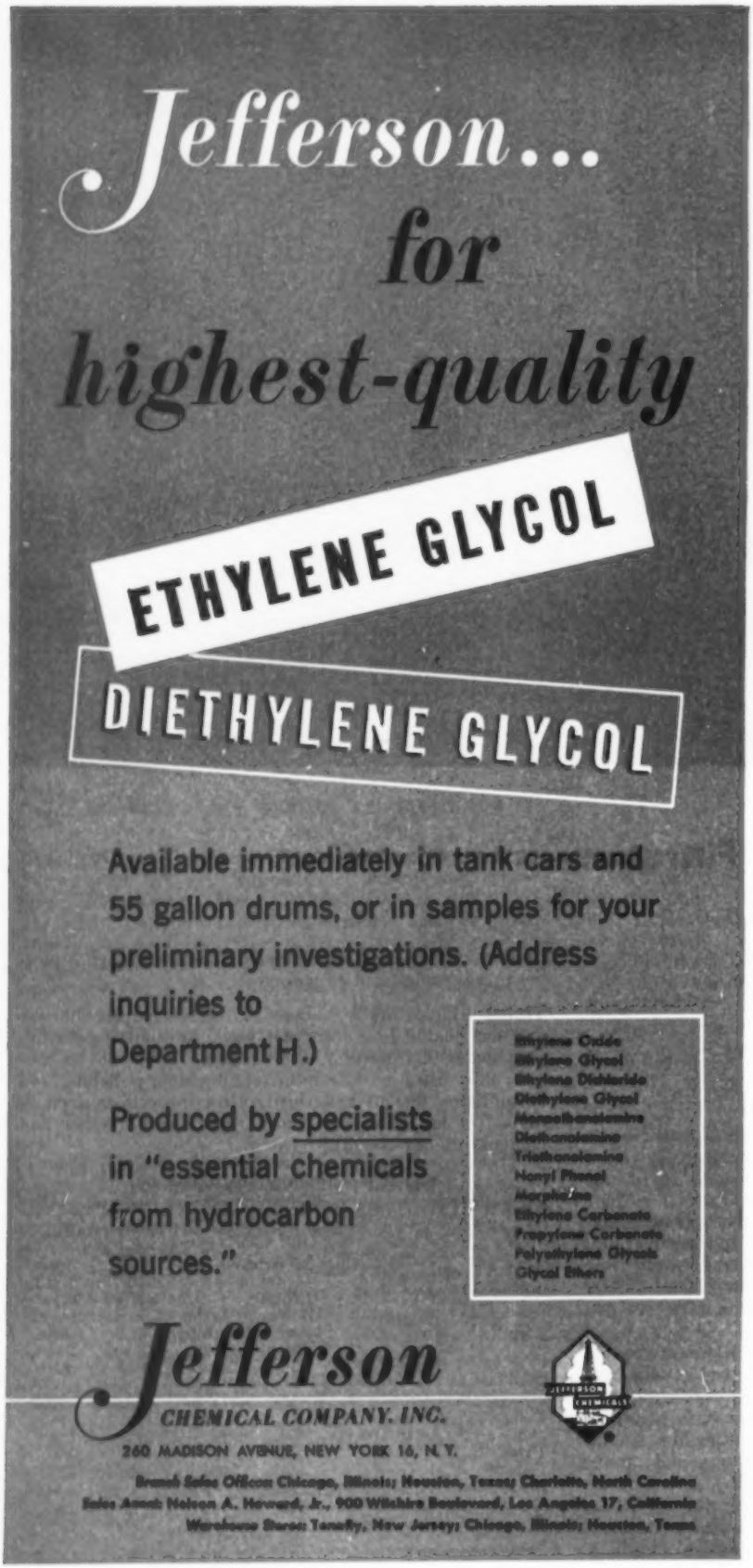
The adsorbent is added to the oil charge and the oil-adsorbent slurry enters a pipe still heater where maximum contact temperature is obtained in a once through operation. From the heater the slurry enters a baffled stripping tower where a level is maintained regulating the time of contact. Steam is passed through the slurry and up the tower to facilitate the stripping action. The slurry is drawn continuously from the bottom of the tower and cooled before being fed to a vacuum filter. The filtered oil is charged to a high vacuum stripper to furnish additional product control. The oil is finally pumped through a blotter press, cooler and to storage.

Yields—Yields are a function of the type of oil charged and the quantity of adsorbent used. Normally, yield approximates 98.5 percent of oil charged.

Contact filtration is a mild refining step, polishing and decolorizing the oil and improving inspections such as carbon residue, oxidation, neutralization number and emulsibility-demulsibility.

Typical Inspections of Lubricating Oils

	Turbine Oil		Phenol Raffinate	
	Stock Before Contact Filtration	After Contact Filtration	Stock Before Acid Tr. and Cont. Filt.	After Acid Treatment and Cont. Filt.
Gravity, API	23.0	23.1	22.6	22.6
Color, ASTM	3	2	4	1½
Viscosity S.S.U. @ 100 F.	508	495	372	364
Flash, °F.	395	410	395	400
Fire, °F.	445	450	440	440
Neutral No.	0.03	0.02	0.9	0.06
Steam Emulsion No.	460	35	.....	.....
Conradson Carbon Residue	.....	.....	0.03	0.02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Briefs

From recent literature

No. 6 in a Series

Lubricating grease compositions which are resistant to the solvent action of low boiling hydrocarbons are prepared by replacing the water of an inorganic hydrogel (e.g., silica gel) with ethylene glycol. After the ethylene glycol is added to the hydrogel, the gel is mixed in a steam-heated mill to evaporate the water and reduce particle size.

Sterilization of air to kill bacteria, viruses and molds is accomplished by introducing vapors of ethylene glycol into ventilation systems.

Paper coatings which are flexible and grease-proof are prepared from emulsions of plasticized polyvinyl acetates. These emulsions consist of a monoester of a glycol such as diethylene glycol, and an abietic acid having a terminal hydroxyl group.

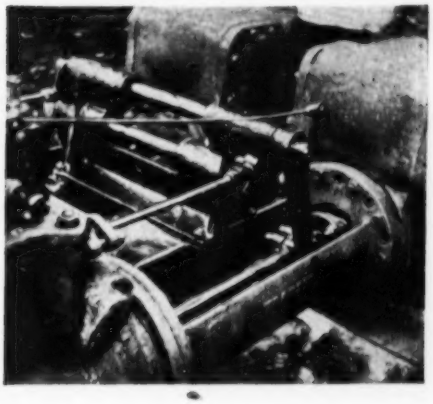
Fiber-forming polyesters are produced by reacting ethylene glycol and a dicarboxylic acid. The reaction takes place at reduced pressures and elevated temperatures. These polyesters may be also used as softening agents, coatings, and film-forming substances.

Abrasive suspensions for grinding or polishing various types of hard materials can be prepared by suspending small particles of silicon carbide, aluminum oxide or other abrasives in a medium consisting of a fatty acid ester of ethylene glycol.

These developments are abstracted from recent publications or U. S. patents. They may suggest applications of Jefferson Ethylene Glycol and Diethylene Glycol in your products or processes.

In this tank, where oils are treated with sulfuric acid, a coned bottom made of ½-inch Monel plate has successfully withstood corrosion since its installation in 1950.

Monel rods in acid sludge pumps at Atlantic's Philadelphia refinery last 10 to 12 months as compared to 5 months for brass or carbon steel. Service is severe since sludges must be steamed to increase their mobility.



Recent practice in

Controlling Dilute Sulfuric Acid and Acid Sludge Corrosion

When it comes to handling sulfuric acid and acid sludges in the refinery, there is a realm where neither lead, steel, nor copper-base alloys answer the equipment problem adequately. In such cases, the high-nickel alloys have often proved to have the most useful combination of chemical and mechanical properties.

For example, The Atlantic Refining Company had to repair a large outdoor tank used for acid treatment of light industrial oils. They wanted a better material for the coned bottom, in which deposits of acid sludge accumulate, and decided to try Monel. That was in 1950. The Monel was installed and has stood up without any need for repair ever since.

Similarly, when Atlantic found they were getting only 5 months' service from brass or steel rods in their acid sludge pumps, they substituted Monel. The Monel rods have been giving 10 to 12 months service. (Even longer service has been reported with heat-treated "K" Monel rods which also have greater resistance to scoring.)

Monel is also used in many refineries for valves and lines handling dilute sulfuric acid.

In general, Monel is used to handle sulfuric acid where a combination of good corrosion resistance and high mechanical properties—high strength and little or no creep—are needed. Its practical application is limited to reducing conditions and to concentrations below 80-85% at room temperature (or 12-15% in boiling solutions).

More information on controlling sulfuric acid corrosion is contained in Inco's Technical Bulletin T-3, "Resistance of Monel, Nickel and High-Nickel Alloys to Corrosion by Sulfuric Acid." It is yours on request.

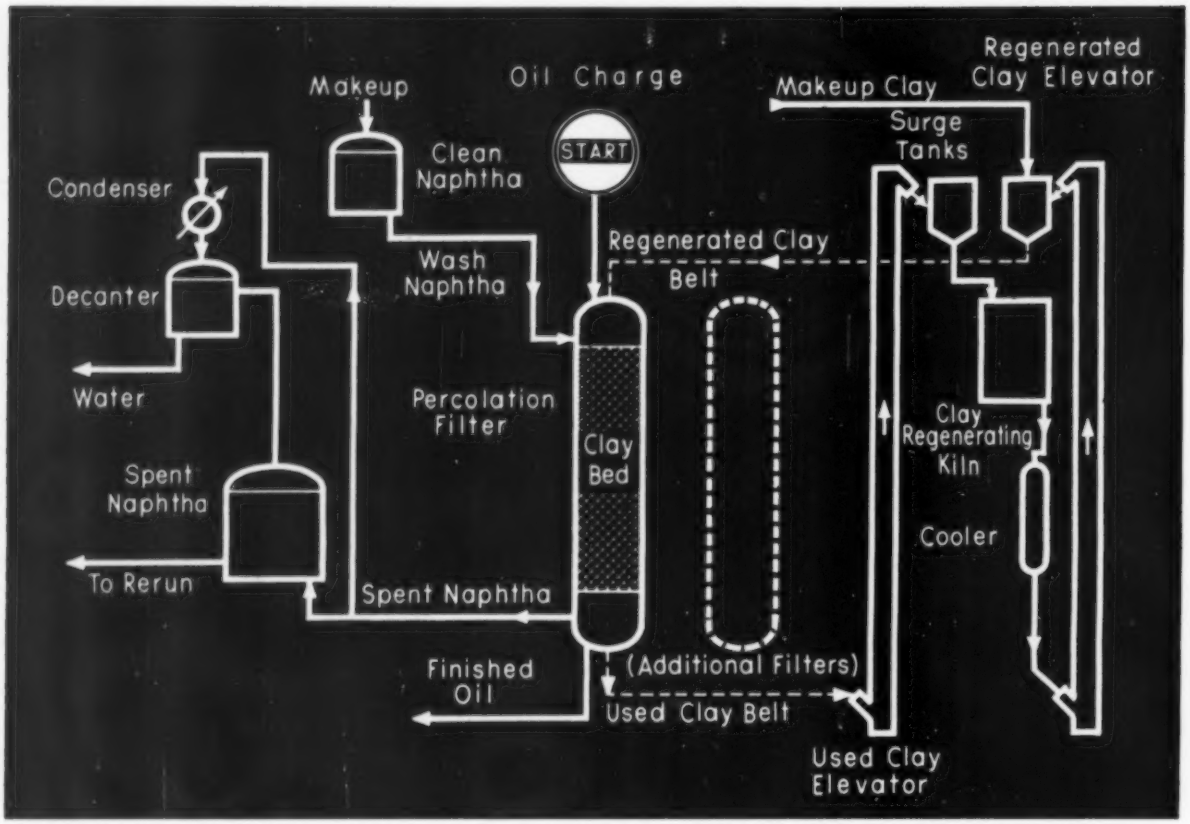
And if you have such a corrosion problem, be sure to contact Inco's Corrosion Engineering Section. They will be glad to help you without cost or obligation.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO Nickel Alloys

Monel ... *for minimum maintenance*

For more data on advertised products, use Readers' Service Cards, last page.



Percolation Filtration—MINERALS & CHEMICALS CORPORATION OF AMERICA

Application—The process is applied for finish refining of lube oils and other fractions.

Product—Finished oils and waxes are characterized by excellent color, odor and taste, and by their stability in demulsifying properties.

Description—The process consists of filtering the oil or other charge through a vessel commonly containing 10 to 50 tons of adsorbent media, either fuller's earth or activated bauxite. After a preliminary period during which the clay bed is thoroughly soaked with charge oil, the latter is passed through the clay until the adsorbent fails to produce specification products. The first oil out is lightest in color. The color of the effluent oil darkens gradually as more and more oil flows through the unit. After the oil stream has stopped, naphtha is sent through the clay bed to reclaim the remaining oil. Steaming follows to recover the naphtha. The clay is then conveyed to a kettle for burning off the carbonaceous deposits of oil and impurities and returned to the filter for another cycle. The 20/60 and 30/60 mesh adsorbent grades have been found to be best adapted to most percolation refining operations.

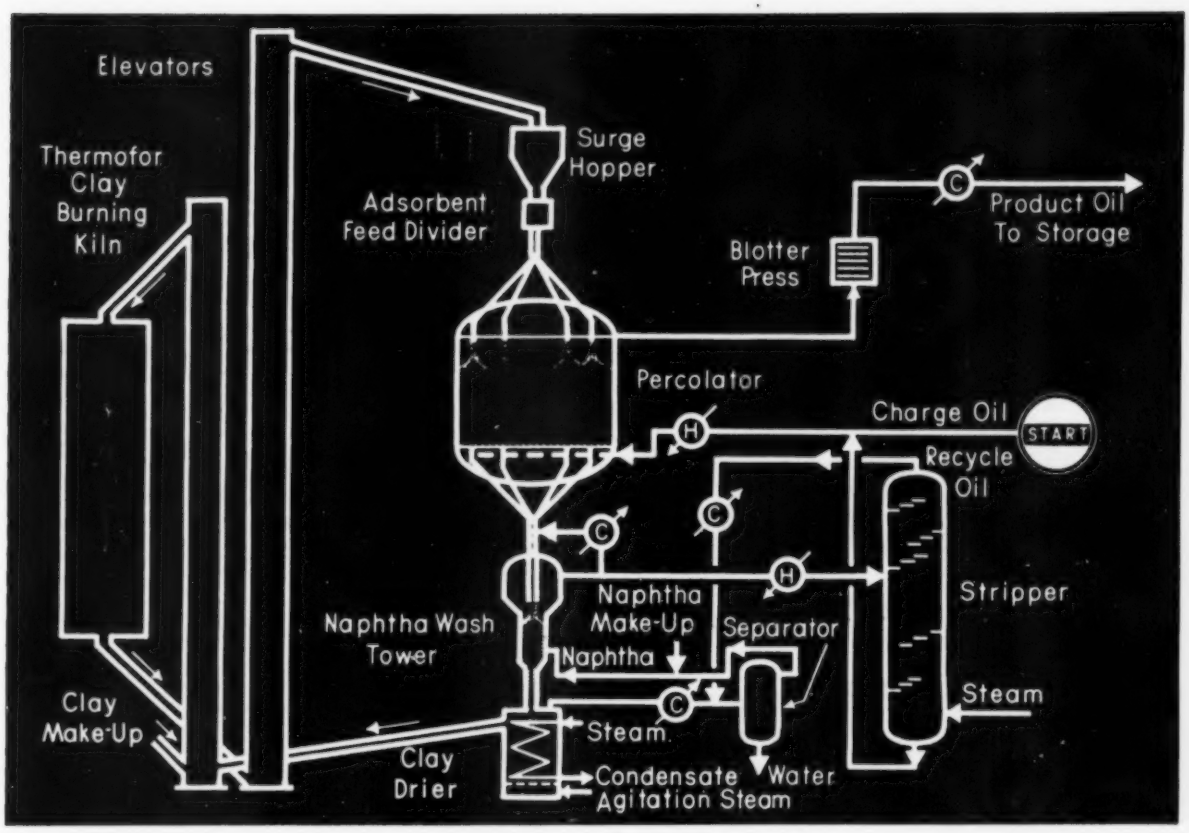
The choice between activated bauxite and fuller's earth as the preferred percolation adsorbent is predicated on comparative costs and product quality considerations. In many cases the same high product quality is possible with either adsorbent and the choice may rest solely on any difference in capital investment required or on operating costs. These costs considerations are influenced mostly by the relative yields of filter finished oils which the two are able to produce. The relative yields will vary with different oils, the principal factors influencing them being crude oil source and the amount of refining pre-treatment lubricating oil fractions received prior to filter finishing. Generally it is the case that heavy decolorization requirement on the filters will favor fuller's earth while lighter color loads (less color reduction) will favor bauxite.

Yields—See table.

Commercial Installations—More than 53 installations.

Crude Source	Processing (A)	Processing (B)	Processing (C)	Unfiltered Oil Inspection: API Gr.	Viscosity-S.U. 100°F.	Viscosity-S.U. 210°F.	Viscosity Index	Pour Point °F.	Color NPA	Percolation Yield: New Fullers Earth Bbl/Ton	New Fullers Earth Bbl/MCF	New Bauxite Bbl/Ton	New Bauxite Bbl/MCF	Color NPA
N. La.		P	MEK	28.0	207.0	46.5	92	—10	2—	77	1280	48	1360	1½
W. Tex.		D	MEK	32.7	208.8	47.4	103	—5	1¼	257	4270	151	4270	1
Cal-Waxy		P	P	28.9	325.7	51.5	76	—5	4 dil	84	1395	65	1840	2
Iraq		F	MEK	28.1	457.0	60.8	95	0	7¼	160	2650	130	3690	3
Okla.		F	MEK	29.1	511.6	62.6	90	0	4¼	52	865	114	3230	2
E. Tex.	Yes	D	MEK	27.7	1115.7	92.4	93	0	8	25	415	23	642	4
E. Tex.	Yes	P	MEK	27.4	1678.2	117.3	94	5	5¼	52	865	47	1330	5
W. Tex.	Yes	D	MEK	26.6	1618.3	119.3	99	5	7—	63	1045	60	1700	6

(A) Propane desasphalting. (B) Solvent extraction—P = Phenol, F = Furfural, D = Duosol. (C) Dewaxing—MEK = Methylethylketone—benzol, P = Propane.



Thermofor Continuous Percolation—SOCONY-VACUUM OIL COMPANY, INC.

Application—The process provides the refiner with a modern method for decolorizing lubricating oils and waxes.

Charge—Waxes and lube oil base stocks that have been solvent refined, acid treated, or distilled are fed to TCP units for color improvement and stabilization.

Description of Process—A TCP unit may be divided into a percolation section, a naphtha-wash section, and a regeneration section. The percolation section includes a decolorizing tower and its auxiliary equipment for feeding and withdrawing oil and clay. The naphtha-wash section includes a wash tower, with its auxiliary equipment, and a clay drier. The regeneration section consists of a Thermofor clay-burning kiln, and the elevators and conveyors for transporting the clay. The process steps will be described using the accompanying flow diagram. The oil to be decolorized is preheated and introduced into the bottom of the percolation tower through a multi-nozzle distributor. The product oil is taken overhead through a blotter press to remove traces of entrained clay; it is cooled; and it is then sent to storage.

Regenerated clay from the kiln is fed into the top of the percolator and distributed over the cross-section of the tower through a number of feed legs. The clay falls through the oil in the settling zone, and merges with the clay bed. The rate of clay feed is adjusted to give the desired product color. The spent clay is withdrawn from the bottom of the percolator through a multi-pipe drawoff system. The drawoff rate is controlled automatically to maintain a constant bed level in the percolator. About an equal volume of oil is discharged from the tower with the spent clay.

The spent-clay stream from the percolator drops into the top of the wash tower, and the spent clay is washed countercurrently with naphtha in an operation similar to the percolation step. The naphtha-oil solution taken overhead is charged to a stripper where the naphtha and oil are separated. Stripped oil is recycled to the percolator with the fresh feed, and the naphtha is returned to the wash system. A portion of the wash-tower overhead stream may be cooled and recycled, if necessary, to prevent boiling of naphtha by contact with the hot oil-clay slurry in the top of the wash tower. The control of bed level in the wash tower is similar to that in the percolator.

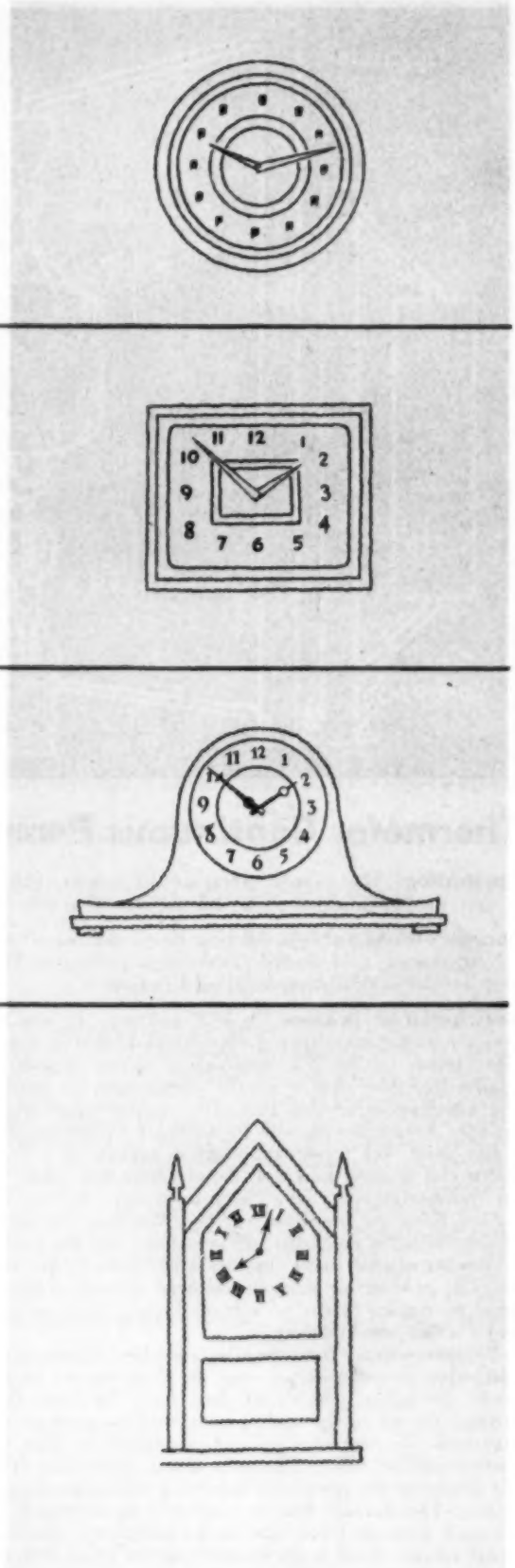
The washed clay, containing some naphtha, enters a drier, from which dry clay free of naphtha is withdrawn continuously. The naphtha vapor from this drier is condensed and recycled to the washing system. The dry spent clay is regenerated in a conventional Thermofor clay-burning kiln.

Operating Conditions—By adjusting oil-stream viscosity to 5 centipoises or lower, oil-thruput rates of 10 to 20 barrels per day per square foot of column can be obtained. This adjustment can be made entirely by temperature, thus eliminating the need for naphtha dilution, even on heavy stocks. Temperatures corresponding to a viscosity of 5 centipoises range from about 125 F. for transformer oils to 350 F. for heavy residual stocks.

Commercial Installations—A 2100-barrel-per-day TCP unit recently went into operation at the Vacuum Oil Company, Ltd., refinery at Coryton, England, and a licensed 3000 barrel-per-day TCP unit is under construction in Holland.

Down time means lost production for processors. "On stream" time means money in the bank. Wolverine products are designed to help you because . . .

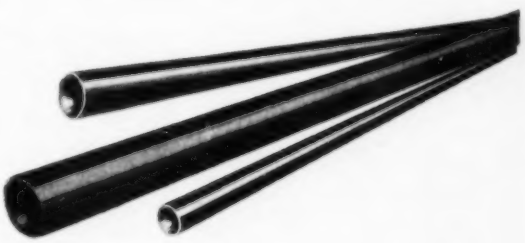
Your Time is Important!



For more data on advertised products, use Readers' Service Cards, last page.

On jobs where additional heat transfer in the same space is needed, Wolverine Trufin* Type S/T condenser tubing steps up the punch of shell and tube exchangers. Trufin's integral fins resist the shock of vibration and temperature change. That means a highly effective fin during operation. Too, Trufin can be substituted directly for prime surface tubes—can be rolled or brazed into headers by conventional methods.

Of course, in some applications, economics dictate the use of prime surface condenser tube. To save time for processors, Wolverine offers a one-source service: condenser tube in copper (and its alloys), aluminum, or electric-welded steel and in a wide variety of sizes. Trufin, incidentally, is available in these metals, too!



Another way to save time is to purchase a complete plain or finned U-Bend condenser tube installation and have it shipped in Wolverine's expendable box-type pallet. Wolverine uses your prints to arrange the U-Bends in the exact order of installation. All you have to do is feed them directly from pallet to condenser.

And then, too, when "sticklers" arise—questions concerning corrosion, alloys, heat transfer, other technical problems—Wolverine offers a complete Field Engineering Service. That's a good way to save engineering time.

Intriguing possibilities? Yes! You'll find more of the Wolverine time-saving story when you read the new books on condenser and heat exchanger tubes and the technical aspects of Trufin. Write for your copies—today! WOLVERINE TUBE, Division of Calumet & Hecla, Inc., 1437 Central Avenue, Detroit 9, Michigan.

*REGISTERED U. S. PATENT OFFICE

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario.

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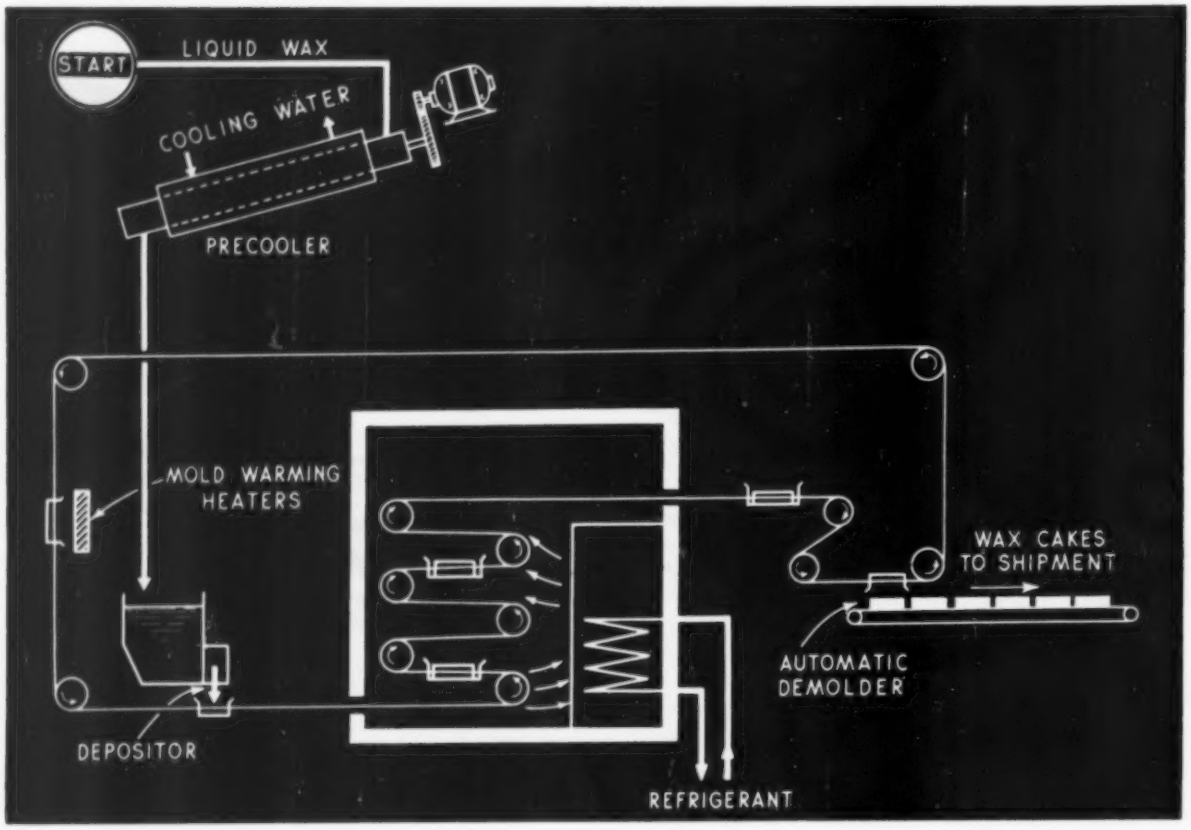


Continuous Wax Molding—J. W. GREER COMPANY

Application—The Continuous Wax Moulding Process is a completely automatic unit or machine for processing liquid wax into finished ten or eleven pound slabs.

Product—Various types of paraffin and microcrystalline waxes. The machine moulds slabs of any weight between 9.75 and 11.25 pounds at production rates up to 15,000 pounds of wax per hour. A separate model is also available to slab ¼-pound cakes at production rates up to 2500 pounds per hour.

Description—The accompanying diagram illustrates the process performed by the 10-pound machine. The machine consists of five sections: pre-cooling unit, depositor, multi-tier cooling conveyor, refrigeration system, and an automatic demoulding and unloading mechanism.

The pre-cooler is composed of a series of jacketed steel tubes; the number of tubes varying according to the production requirements of the machine. Function of the pre-cooler is to constantly deliver liquid wax to depositor at a pre-determined moulding temperature. Accurate wax temperature control is accomplished by automatic valves that admit either steam or cold water to the pre-cooler jackets as demanded by an automatic temperature controller.

The volumetric depositor consists of a jacketed steel hopper and a depositor head composed of six cylinders and pistons for depositing liquid wax into mould pans. Each tray holds individual cakes to within $\pm\frac{1}{2}$ to 1 percent in weight for a given setting.

After the liquid wax is deposited in the mould pans, it is conveyed through the tiers of an encased multi-tier cooling conveyor. Cooling time is variable according to the wax being processed.

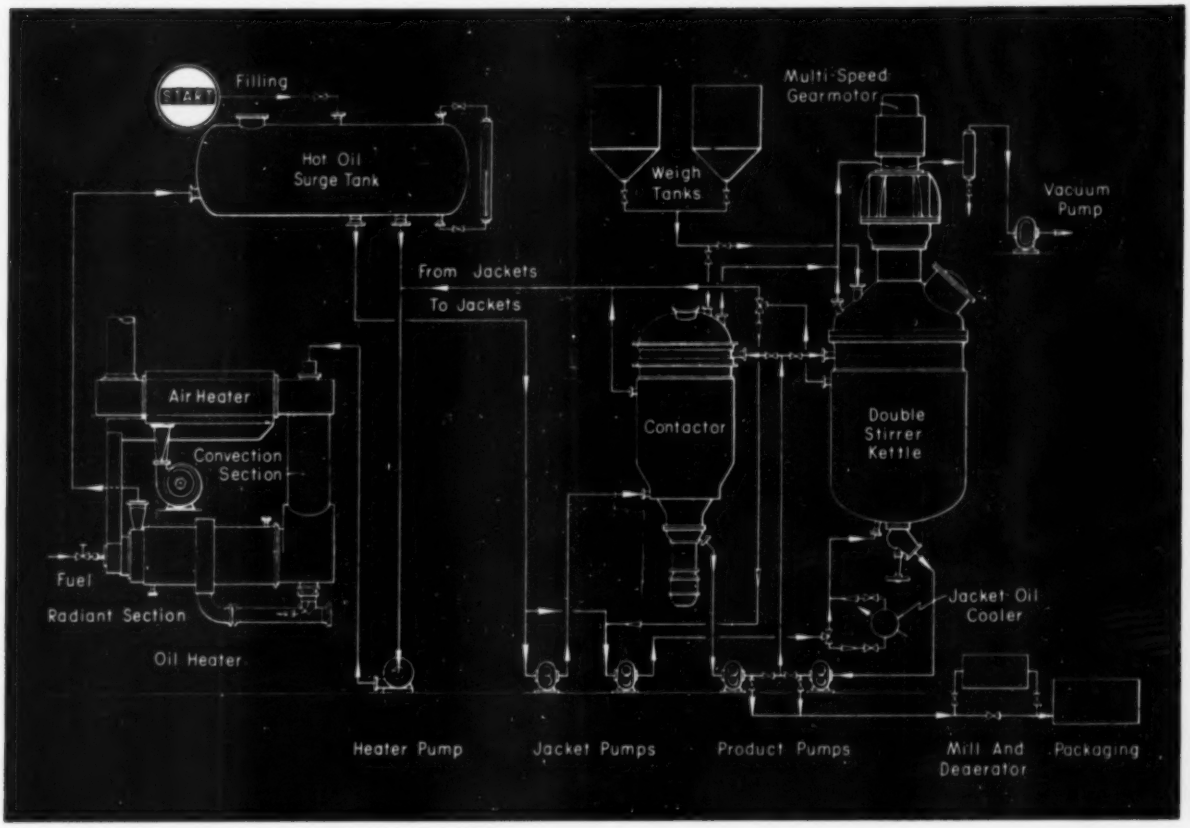
The wax is cooled and solidified during its travel through the cooling conveyor by the medium of cold air circulated from cold diffusers. Air circulation is lateral through upper tiers of the conveyor and returned back across lower tiers; then through the diffuser coils to be recooled and recirculated. The refrigeration system employed to cool the circulating air may be one of many, whichever is best suited to the particular installation.

After traveling through the cooling cycle, the completely cooled and solidified wax slabs are gently dropped onto an unloading conveyor by automatically inverting the mould pans and trays. Inverting of the trays is in exact timed relation to an intermittently operated cross-discharge conveyor belt which delivers the finished slabs to a packaging or shipping point.

Operating Conditions—The six major process variables are:

1. Wax melting point.
2. Input wax temperature.
3. Center temperature of finished slabs.
4. Weight of finished slabs (within the range of 9.75 to 11.25 pounds.)
5. Conveyor speed and consequent output of machine.
6. Air temperatures in refrigerated chamber.

Commercial Installations—The first unit was installed at Beaumont, Texas, in December, 1950. Five others are in operation and two additional machines are under construction.



Grease Manufacturing—STRATFORD ENGINEERING CORPORATION

Application—The process is applied to the manufacturing of a wide range of lubricating greases.

Charge—Various compounds of fatty acids and alkali earth metals to form a soap, together usually with oils of petroleum source.

Products—Lubricating greases such as calcium, soda, lithium, barium, aluminum, mixed base and non-soap base greases of desired specifications.

Description—The process involves accurate weight control on all feed components, intimate mixing, rapid heating and cooling, together with milling, dehydration and deaeration wherever required. The accompanying flow sheet illustrates the process arrangement of the three principal items of equipment: the internally fired oil circulation heater, high dispersion contactor and double stirrer process kettle.

In general, the required ingredients for producing a soap are charged through weigh tanks into the contactor where mixing is induced by an axial flow impeller located in the lower end of the circulation tube, promoting rapid circulation of the entire mass in a large cyclic stream. Heating is supplied to the shell jackets and the contactor circulation tube by a jacket oil pump circulating hot oil—400 to 600 F.—from the hot oil surge tank. An extremely short time cycle is required to complete the saponification reaction after which excess water may be removed through a vacuum line. The soap and the remainder of the oils then may be charged into either the contactor or into the double stirrer kettle where final mixing is accomplished and the grease is finished to specification.

All of the heavier types of greases are normally finished in the double stirrer kettle owing to the high viscosity that prevails at finishing temperature.

Mixing and circulation of the contents of the kettle are achieved by two counter-rotative pumping assemblies arranged to turn over the entire contents of the kettle and also to create interstage recirculation between the two sets of impellers.

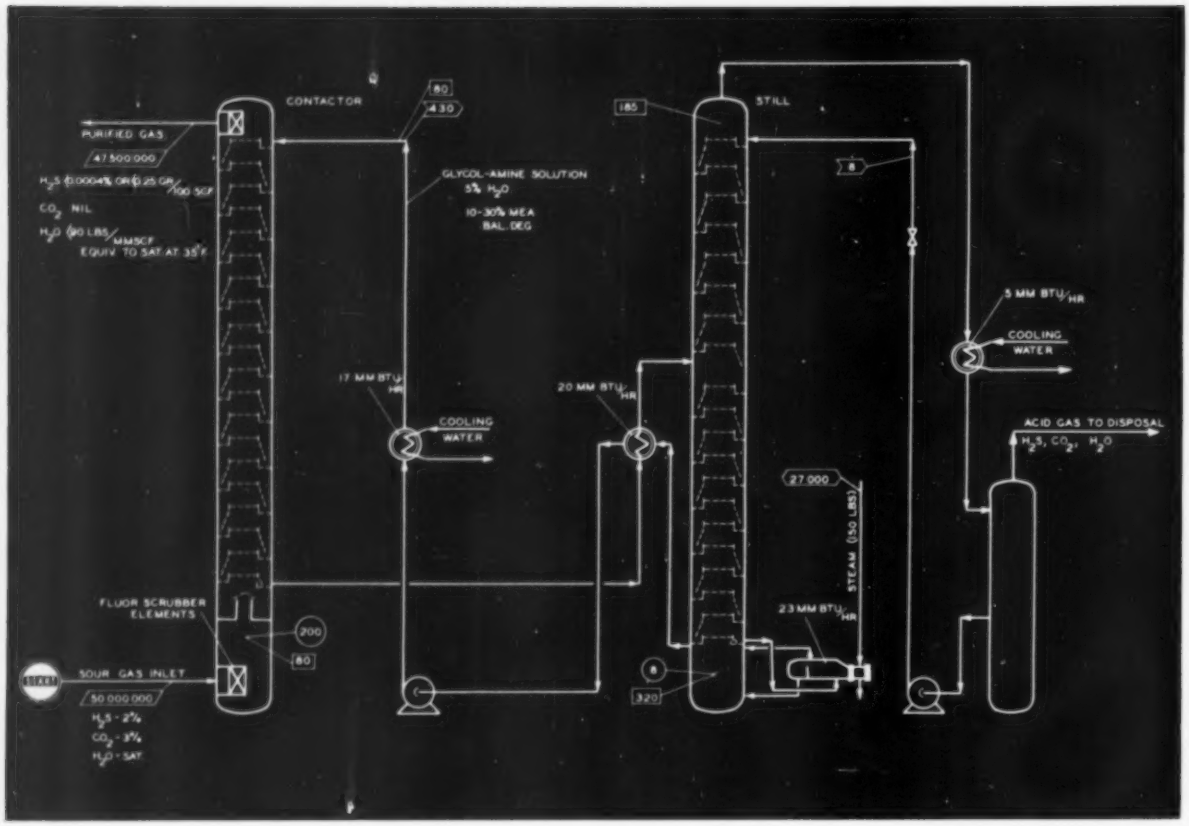
The double stirrer kettle shell is jacketed for either oil heating or cooling. The inside surface of this shell is smoothly machined for the application of multiple scrapers provided to scrape the shell side wall cleanly and thus maintain a high rate of heat transfer. On a heating cycle the kettle jacket pump circulates hot oil from the surge tank through the kettle jacket. On a cooling cycle the same kettle jacket pump is used. However, the flow of oil is directed through a heat exchanger to the kettle jacket and returned directly to the pump suction.

The finished grease from either the contactor or double stirrer kettle may be packaged directly or further processed in a mill, dehydrator or deaerator as required by the specifications of the final product.

Typical time cycle for the finished manufacture of a calcium grease falls in the range of $1\frac{1}{2}$ to $1\frac{3}{4}$ hours while that for a soda base grease approximates 2 to 3 hours.

Pilot plant grease manufacturing equipment is normally used in conjunction with commercial equipment for the purpose of plant guidance and the development of new and improved grease formulations.

Commercial Installations—Many units of this type have been in continuous operation for many years both in this country and abroad.



Glycol-Amine Gas Treating—THE FLUOR CORPORATION, LTD.

Application—The process is applied for the continuous removal of hydrogen sulfide, carbon dioxide, and water vapor from gas streams. By the use of methyldiethanolamine, this process may be adapted to remove water and hydrogen sulfide from gas streams with selective removal of CO_2.

Product—Sour natural gas may be treated so that the residue gas will contain a guaranteed maximum of 0.15 grain of H_2S per 100 scf and be dehydrated to a degree equal to that obtainable with a straight glycol dehydrator.

Description—The process utilizes a mixture of amine (commonly monoethanolamine) and glycol (di- or triethylene glycol) in a simple regenerative cycle. As shown in the flow diagram which represents a typical application, the sour gas is introduced into the bottom of the absorbing column, the contactor. As it passes upward through the bubble trays it is thoroughly contacted with the glycol-amine solution, which enters at the top of the vessel. The outlet gas, free of the CO_2 and H_2S and dehydrated, leaves the top of this column. The rich solution containing the absorbed acid gases leaves the bottom of the contactor and passes through a bank of conventional heat exchangers, wherein the temperature of the solution is raised. The rich solution then enters the regenerating column, the still. As it flows down over the bubble trays in this column it is contacted with the rising stripping vapors, thus stripping the solution of the acidic constituents. The solution from the bottom tray of the still enters a reboiler, wherein it is boiled to provide the stripping vapor for the column. The overhead stream of acid gas and water vapor from the still passes through a condenser, and the resultant mixture is separated in an accumulator, the acid gases passing overhead from this vessel and the condensate being returned to the still as reflux. The regenerated lean glycol-amine solution leaves the bottom of the still, passes through the exchangers, and is pumped back through coolers to the top of the contactor, thus completing the cycle.

Typical solutions employed in the process may be comprised from 10 to 30 percent monoethanolamine, 45 to 85 percent diethylene glycol, and 5 to 25 percent water. The ability to adjust components of the glycol-amine-water solution makes possible a wide range of specifications for treated gas purity and water content.

Although the primary advantage of such a process over the use of aqueous amine solutions for treating is the fact that dehydration is also obtained, other important advantages have resulted in the use of this process for cases where dehydration is not a prime requisite. These advantages include the ability to produce extremely high purity gas, a lower initial investment, decreased consumption of steam, and more satisfactory operation with regard to such factors as foaming and corrosion.

Yields—As a typical example, one installation in which approximately 60 Mmscf per day of gas containing 450 grains H_2S per 100 scf was treated yielded a purity of less than 0.05 grain per 100 scf.

Commercial Installations—The total installed capacity of glycol-amine plants at this time is in excess of one and one-quarter billion standard cubic feet per day.

Tornado hit here?

People in Lima, Ohio, couldn't even notice a dim-out of industrious sparkle in the lights of Sohio's refinery. On that night, though, hundred-mile-an-hour winds from a nearby tornado knocked out one of the refinery's two, 34-kv utility feeder lines. The "cat cracker's" 3000-hp blower motors were thrown out of synchronization and started an ominous whining slowdown.

In less than 4 seconds, three things happened: a Westinghouse Under-Frequency Relay took the motor drives off the line, so that the rest of the plant load could be reapplied in segments. DH air circuit breakers in

(continued next page)

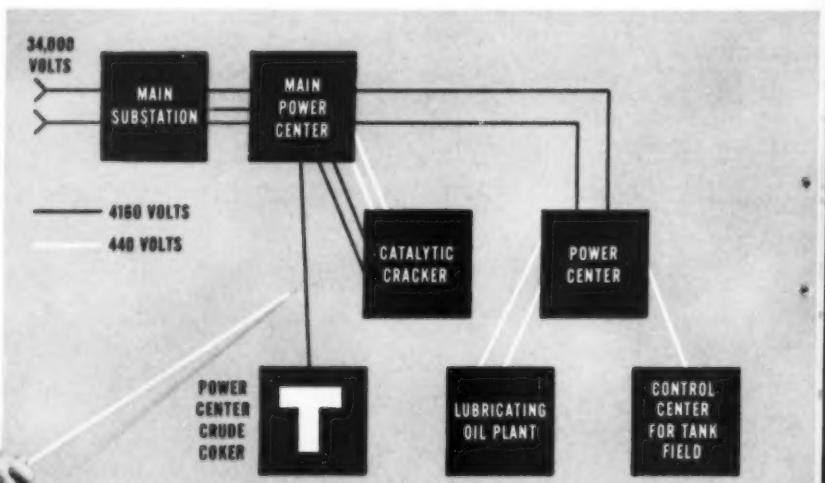
Meet Carl Olson, Westinghouse Industrial Engineer, who reports on how a new conception of power reliability resulted at Sohio's Lima Refinery through electrical distribution and drive control.

the main Westinghouse Switchgear automatically closed, bringing power in from the second utility feeder. Automatic control restarted the blower motors and a $30,000 outage was averted.

This absolute electric power reliability was the result of thorough planning by Sohio Engineers, the Dingle-Clark Co., and Westinghouse. They decided that quick restoration of power is the most efficient method of assuring continuous production from the refinery process. An ingenious control system was installed to automatically clear trouble in 4 to 5 seconds. The resulting electrical system brought important advantages in flexibility, economical operation and simplified maintenance.

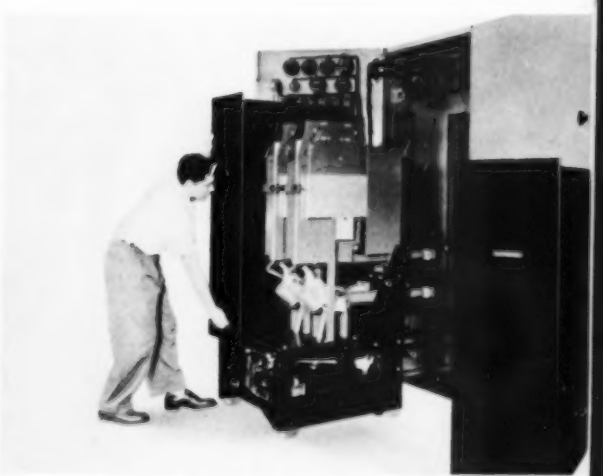
At Sohio's Lima Refinery . . .

Speedy restoration of service is key to process protection



Main Westinghouse Substation distributes power at 4160 volts, through two feeders, to the catalytic cracker and to Westinghouse Power Centers located throughout the refinery where power is brought down to 440 volts.

Westinghouse 4160-volt Switchgear, left, is located in the main substation protecting refinery load of 16,200 kva. It provides under-frequency and automatic-starting control for the main blower motors.



Drawout feature of these high-voltage, Type DH, De-ion® circuit breakers allows them to be changed in only 3 minutes. Inspection and maintenance can be made simply and quickly with minimum disturbance to refinery operations.

. . . System growth at low cost results

The refinery's present duplex system is so planned that Sohio can add additional capacity easily in the future. Sohio engineers point out that they are now using 16,200 kva, and can go up to 25,000 kva without adding additional switchgear.

Standard, unitized construction of Westinghouse Substations and Power Centers will make it easier to expand or rearrange circuits when needed.

Westinghouse Power Centers add economy

Sohio engineers report that the compact and completely enclosed design of Westinghouse Power Centers permits installation near the centers of refinery load with resulting savings in power and cable, and at the same time conserves building space. Voltage loss at distant locations, such as tank-field pumping stations, is prevented. Motor drives operate efficiently at full rating.

Maintenance man-hours limited

On low-voltage circuits Westinghouse AB-I Circuit Breakers cut down maintenance time with 3-step protection. First, these breakers will not trip on light or short-duration overloads. Second, they will trip immediately in case of serious fault, but once the fault is cleared a flip of the breaker handle restores power. There is no time lost locating replacement fuses. Third, AB-I breakers always remain properly calibrated. There's no danger of under or over fusing.

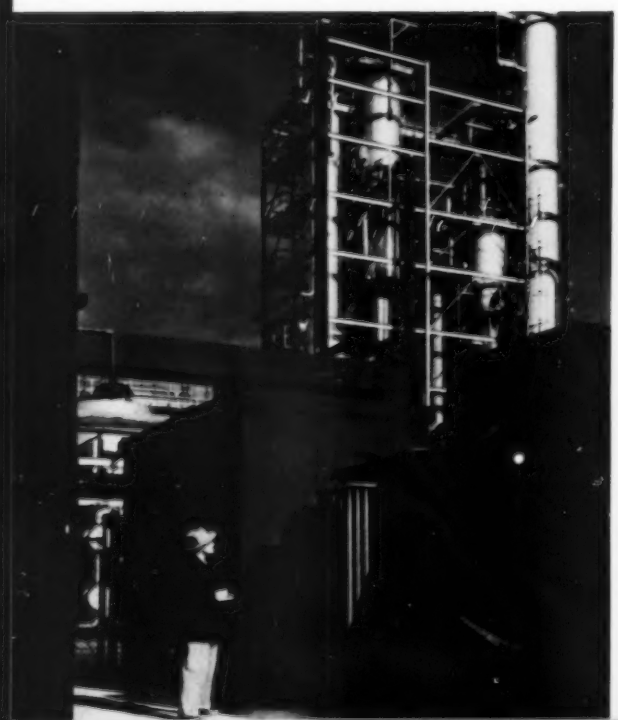
Westinghouse Field Engineering plays a part

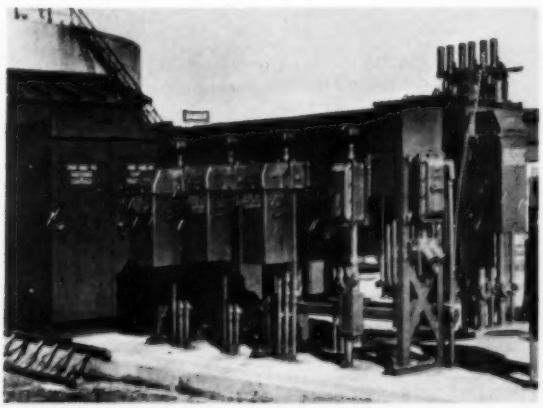
In the event of major electrical equipment damage, Sohio can always rely on Westinghouse Field Engineering Service. Available from 56 Field Service Offices, Westinghouse Engineers are on 24-hour call to take care of emergencies.

In addition, 38 Westinghouse Manufacturing and Repair Plants provide factory-type service. And 31 Westinghouse Renewal Parts Warehouses help to simplify many refinery inventory problems on electrical equipment.

Next page, steam or electric drives . . . how the decision was made.

YOU CAN BE **SURE**...IF IT'S Westinghouse





Oil-immersed, combination Life-Line Starter and AB-I circuit breakers are grouped together providing control and circuit protection for pump motors. Units are easily inspected by lowering oil tanks.

Westinghouse 440-volt, Outdoor Power Center for the Lubricating Oil Plant contains two 1000-kva transformers, 4160/440 volts, and 440-volt air breaker switchgear.

for continuous operation of Sohio's Lima Refinery . . .

Electric drives show lowest cost

Thorough study showed electrical drives to be the most economical way to expand Lima Refinery capacity to 50,000 bbls. per day. Westinghouse experience in supplying both steam and electric drives helped to point out lower electrical installation and operating costs.

Refinery operating efficiency is improved with the help of Westinghouse Motors and Control for the "cat cracker" blowers and synchronous motors on the Lubricating Oil Plant refrigeration compressors. These synchronous drives improve the system power factor and deliver more power per dollar.

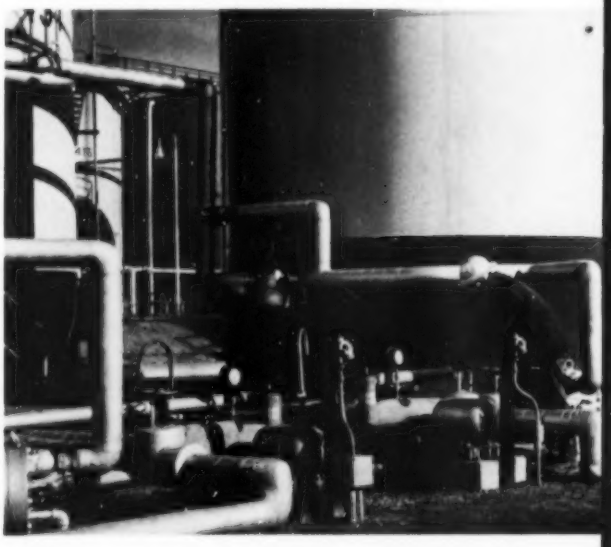
Life-Line® motor drives in the Lubricating Oil Plant and tank field require minimum attention. Sealed, prelubricated bearings and tough conductor insulation protect them from dust, moisture and corrosive action.

In analyzing refinery drive requirements, Westinghouse Engineers can help you with complete impartiality, too. Whether steam or electrical equipment proves more desirable, Westinghouse engineering provides dependable facilities for continuous refinery operation.

What to do NOW! Call your local Westinghouse Representative with questions on any of the equipment discussed. He'll supply you with copies of the literature listed below. Or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.

- ☐ Power Centers B-4162
- ☐ High-Voltage, Metal-Clad Switchgear B-5306
- ☐ Low-Voltage, Metal-Enclosed Switchgear B-5282
- ☐ Dry-Type Transformers B-5920
- ☐ AB-I Circuit Breakers B-5456
- ☐ Preventive Maintenance Booklet B-5477
- ☐ Synchronous Motors and Control B-5300
- ☐ Motors and Control for Petroleum Industry B-5444
- ☐ Life-Line "A" Motors B-6154-A
- ☐ Life-Line Motors (200-700 hp) B-4731
- ☐ Large Induction Motors B-4739
- ☐ Complete Industrial Control and Services B-6051

Two Westinghouse 250-hp, 4160-volt synchronous motors with special enclosures operate safely in hazardous atmosphere. Westinghouse Engineers designed special hoods for purging the motors continuously with fresh air.

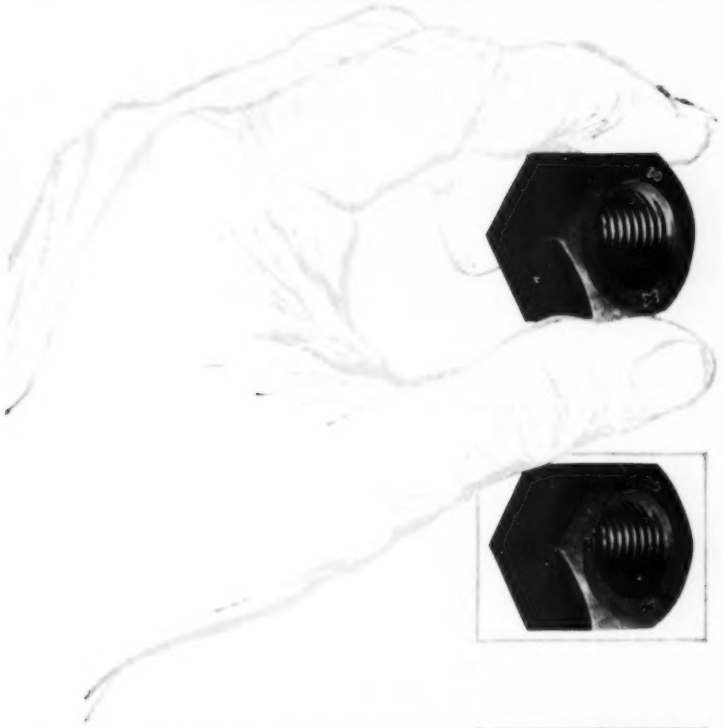


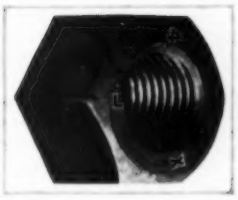
Pumping operations in the tank field are powered by Life-Line motors. Sealed, pre-lubricated Life-Line bearings eliminate the time and cost of greasing maintenance, prevent entry of dirt and moisture into the bearing. MP-3031

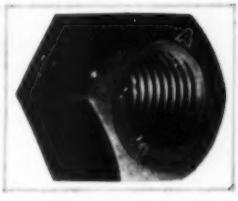
YOU CAN BE **SURE**... IF IT'S

Westinghouse

We make 4 types of nuts to ASTM A-194







To enable refinery engineers to choose from a well-rounded line of nuts for high-temperature, high-pressure bolting, Bethlehem produces four grades of hexagonal nuts meeting ASTM Spec. A-194. These high-quality nuts are tapped to Class 2 fit, and are made in sizes from ⅜ in. to 2 in.

For additional information about any of these nuts, or the carbon or alloy studs with which they are used, drop a line to the nearest Bethlehem sales office.

Grade 2

A medium-carbon steel nut, intended for use where temperatures and pressures are moderate. Carbon 0.40 min, Phosphorous 0.05 max, Sulphur 0.05 max. Brinell hardness 160 min. Carried in stock.

Grade 2H

A quenched and tempered nut, ideal for conditions involving high temperatures and pressures. Carbon 0.40 min, Phosphorous 0.05 max, Sulphur 0.05 max. Brinell hardness 248 to 352. Carried in stock.

Grade 4

A heat-treated molybdenum steel nut, ideal for extremely severe temperature and pressure conditions. Also suitable for sub-zero temperatures, as it has a minimum Charpy impact value of 15 ft-lb down to –150 F. Carbon 0.40 to 0.50, Manganese 0.50 to 0.95, Phosphorous 0.04 max, Sulphur 0.05 max, Silicon 0.15 min, Molybdenum 0.20 min. Brinell hardness 248 to 352.

Grade 1

A low-carbon steel nut suitable for non-critical applications. Can also be used in installations involving moderately elevated temperatures. Carbon 0.15 min, Phosphorous 0.05 max, Sulphur 0.05 max. Brinell hardness 120 min. Carried in stock.

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How they compare:

Gasoline Blending Stocks

- Susceptibilities
- Sensitivities
- Yields versus octane

Robert E. Maples,
Consehlo Nacional do Petroleo
Rio de Janeiro, Brazil

HOW TO UPGRADE gasoline quality is the biggest problem facing refiners today. With many alternatives as to processes and lead levels, the refiner must come up with a plant balance which will make the best use of his blending stocks. He must not only have adequate data and correlations on susceptibilities and sensitivities of each stock but he must also be able to determine optimum yields for a given octane. Though each balance is specific to a plant, there exists a real need for generalized correlations which fill the gaps in specific data and which will permit conversions from one test to another.

The accompanying series of charts provide comparative tetraethyllead susceptibilities and sensitivities of the usual refinery gasoline blending stocks including straight run, thermally cracked or reformed, catalytically reformed, catalytically cracked and catalytic polymer.

To aid in interpreting these charts, another series of charts were drawn for the paraffin, mono-olefin, saturated cyclic (naphthene), and the unsaturated cyclic hydrocarbons.

A third series of charts enable the refiner to refer to some standard octane number the different qualities of gasoline obtained from any given cracking stock by different cracking severities. The method is based on the yield-octane relationships for both thermal and catalytic reforming.

Curve Development—As a result of the shift in emphasis from Motor octane numbers to Research numbers, most of the data in the literature on thermal reforming report only Motor numbers, while the data on catalytic reforming usually show only Research numbers. Also, frequently only clear or unleaded numbers are given or the reverse, leaded numbers without clear numbers.

Therefore, to extend the available data for a comparison of thermal and catalytic reforming, it was necessary to make the correlations presented here.

It was desired to be able to perform the following conversions and the reverse:

1. Motor number clear to motor number with 3cc of tetraethyllead.
2. Research number clear to research number with 3cc of tetraethyllead.
3. Motor number clear to research number clear.
4. Motor number with 3cc of tetraethyllead to research number with 3cc of tetraethyllead.

And to perform these conversions on the following gasolines or naphthas: straight run or reforming stock, thermally reformed, and catalytically reformed.

Straight Run Gasoline—The data on straight run gasolines were taken from the articles on catalytic and thermal reforming (Ref. 1 through 18). The scattering of the data is probably largely due to variation in sulfur content of the various samples. Data on sulfur content were generally not given, so that it was not possible to take this effect into account. Where sulfur data were given, the sample was not considered if the percentage exceeded 0.01, but there are undoubtedly some samples included with greater sulfur contents. Since decrease in tetraethyllead susceptibility due to sulfur compounds is independent of the octane number of the fuel and only slightly different for fuels of different compositions,[64] a series of lines could be drawn parallel to the susceptibility curves to represent different concentrations of sulfur. The curves for straight run gasolines are shown as Figures 1, 2, 3, and 4.

(1) straight run gasoline . . .

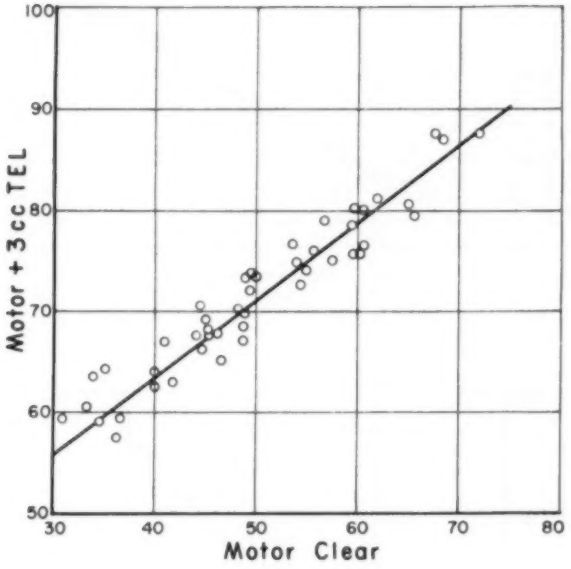


Figure 1. Motor method susceptibility.

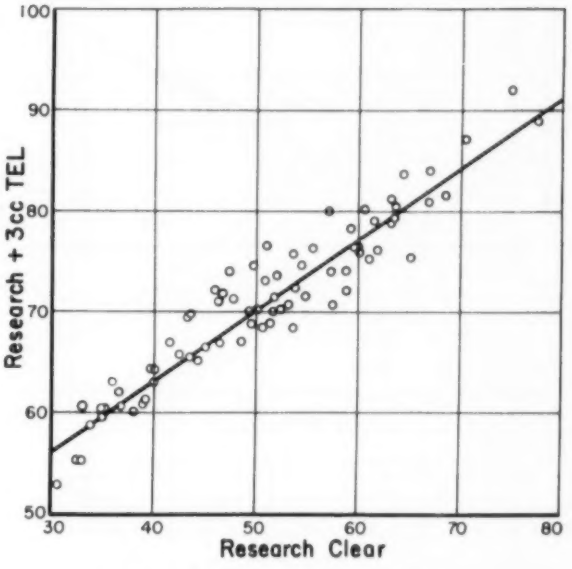


Figure 2. Research method susceptibility.

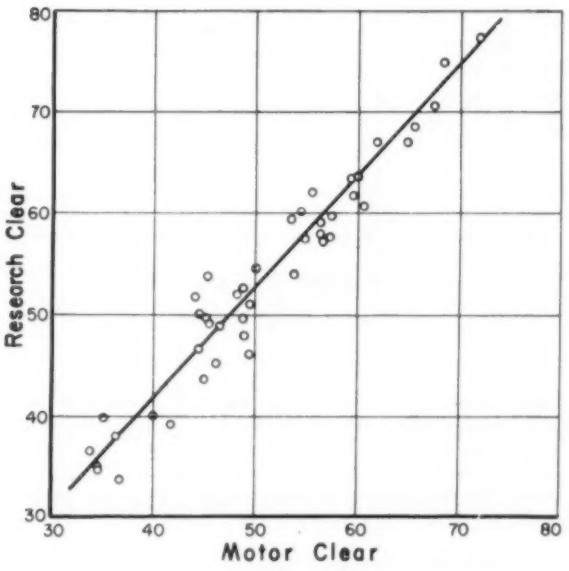


Figure 3. Clear sensitivity.

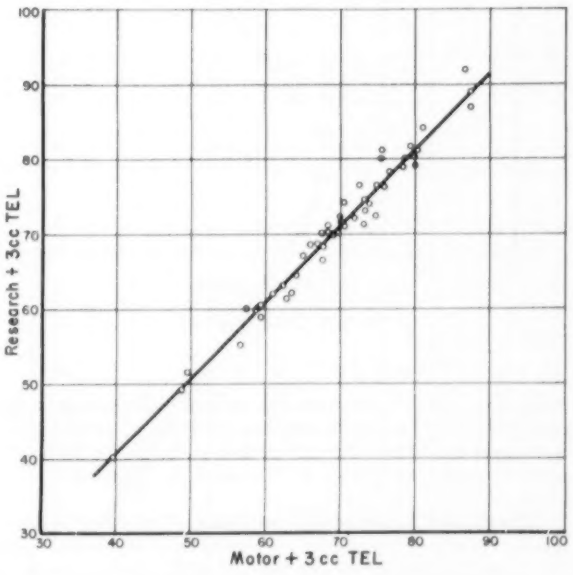


Figure 4. Leaded sensitivity.

Figure 1, giving motor method TEL susceptibility, checks well with tabulated data, presented by Nelson,[66] lying 1 to 1½ numbers higher than Nelson's data in the 40 to 76 octane number range. Nelson's high-sulfur data lie approximately 5½ numbers below the author's curve in the 46 to 72 octane number range.

Sulfur has the same quantitative effect (causes the same loss in tetraethyllead efficiency) on lead susceptibility by the motor method as by the research method.[63] Therefore, points which lie well off the lead susceptibility curves can lie close to or on the leaded sensitivity curves and this is seen to be the case generally (i.e.: less scattering to the points on the sensitivity plot than on the susceptibility plot). Sensitivity is defined as the response of a motor fuel to the change in engine severity between the operating conditions of the ASTM research method (D 908) and ASTM motor method (D 357).

Catalytically Reformed Gasolines—Many articles have appeared in the literature in recent years on catalytic

(2) catalytically reformed gasoline . . .

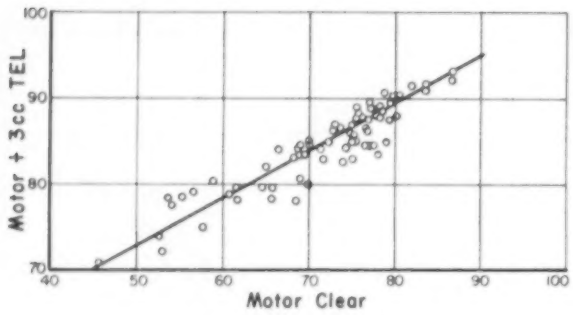


Figure 5. Motor method susceptibility

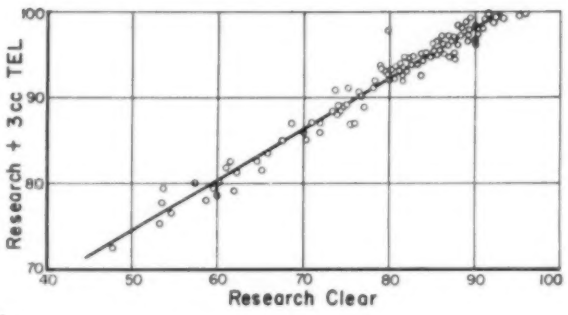


Figure 6. Research method susceptibility

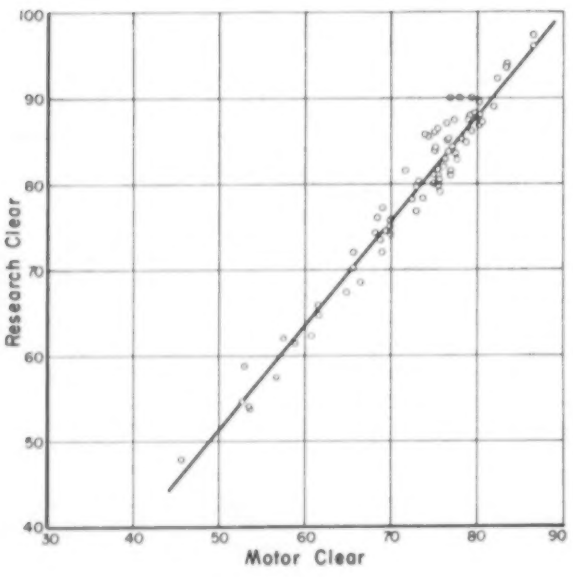


Figure 7. Clear sensitivity

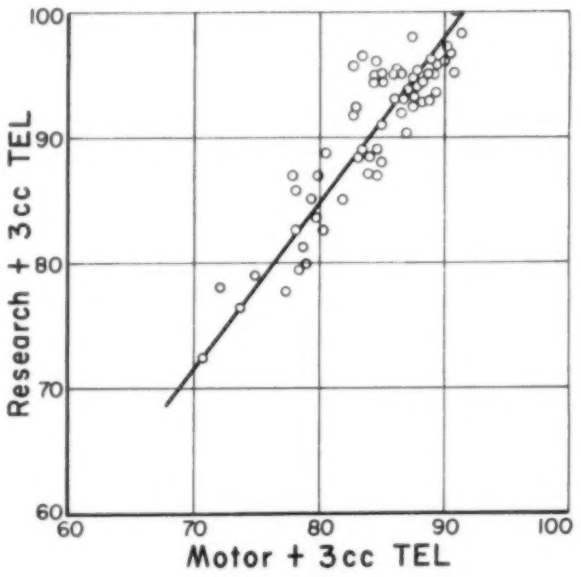


Figure 8. Leaded sensitivity

reforming (Ref. 5 through 28) so that sufficient data are available to define fairly well the behavior of catalytically reformed gasolines. Curves for this stock on the four sets of coordinates are shown as Figures 5, 6, 7, and 8.

Thermally Reformed Gasolines—The data for thermally reformed gasolines[1,2,3,4] have been combined with the data for thermally cracked gas oils, since it appears that a single line can be used to represent them. Gasolines from cracking some light distillates and residual stocks do not seem to fit the susceptibility curves, but do appear to follow the sensitivity curves. In view of the earlier observation that the sensitivity of a stock is independent of sulfur content, this behavior indicates that the discrepencies are due to variations in sulfur content. The four curves for this stock appear as Figures 9, 10, 11, and 12.

Figure 9, giving motor method lead susceptibility, checks well with Nelson's data,[67] averaging about 2 numbers above Nelson's data.

Figure 11, showing clear sensitivity follows closely Figure 4 of TML-8,[4] with a deviation of minus 2 numbers at 50 motor octane clear; minus 1 at 60; and essentially coincident from 70 to 80. Nelson's data[67] lie from ½ number above at 65 to 3 numbers above at 73. Wagner's data[71] lie less than 2 numbers higher than the author's curve over the range of 40 to 65.

Catalytically Cracked Gasoline—The data for catalytic cracking (Ref. 29 through 49) do not cover a wide range on any of the four sets of coordinates. Therefore, the slope of the line was taken as intermediate between the slopes of the corresponding curves for thermally cracked and catalytically reformed stocks. There is little difference in the slopes of these two stocks. The resultant four curves are Figures 13, 14, 15, and 16.

Nelson has published data[68] which can be checked against all four curves and it is found to lie within two numbers of the present set of curves in every case.

Catalytic Polymer Gasoline—Few data are found in the literature on the sensitivity and susceptibility of cata-

(3) thermally reformed gasoline . . .

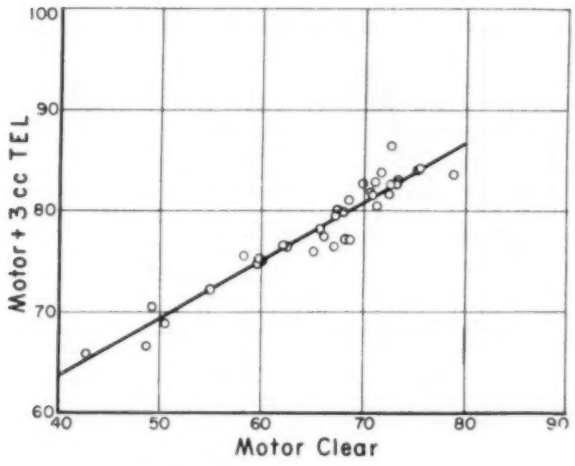


Figure 9. Motor method susceptibility

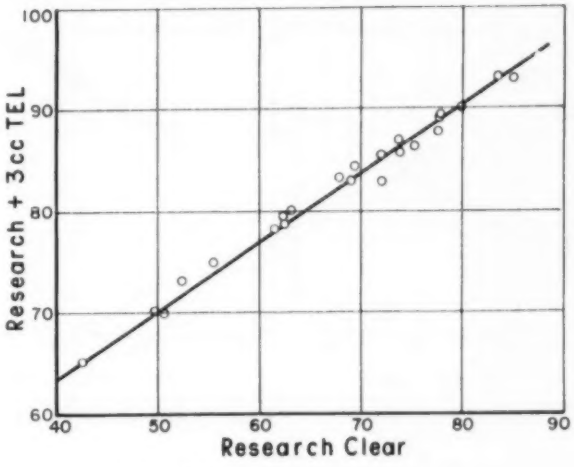


Figure 10. Research method susceptibility

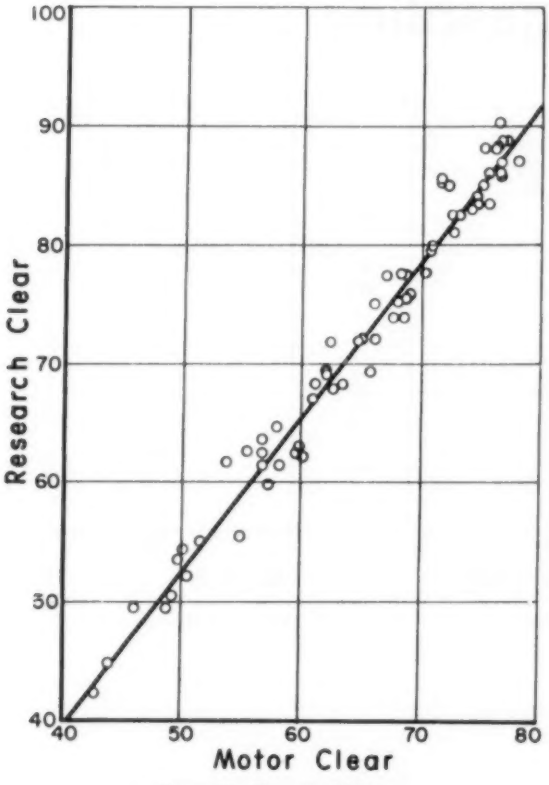


Figure 11. Clear sensitivity

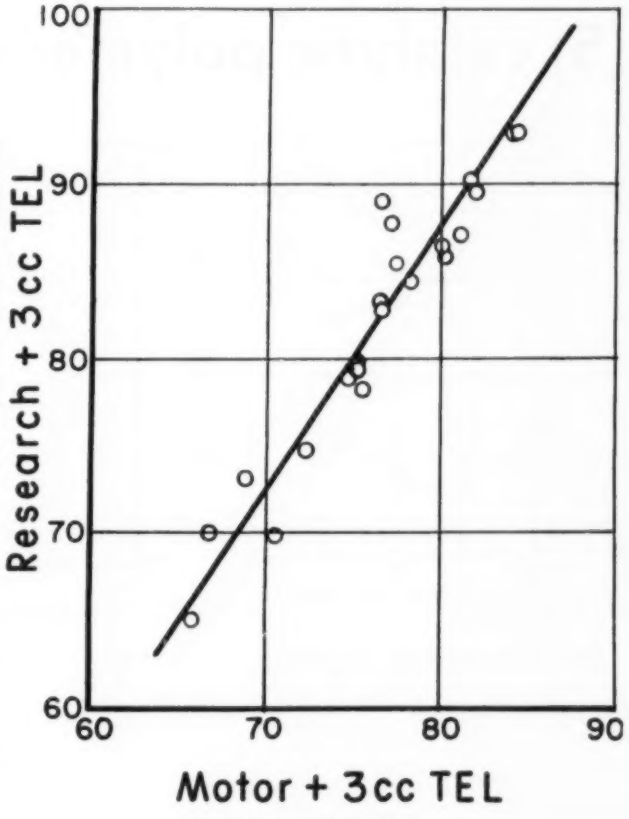


Figure 12. Leaded sensitivity

lytic polymer gasoline (Ref. 50 through 59). This is possibly due to the fact that cat poly gasolines normally cover such a small range of octane numbers and are used in such low percentages in market gasolines. However, they are credited with very high blending octane numbers and are deserving of considerable study in view of the upward trend in quality demand. Because of the scarcity of data and of the olefinic nature of catalytic polymer, the curves were drawn with the same slope as the corresponding curves for the mono-olefins. The resultant curves are

(4) catalytically cracked gasoline . . .

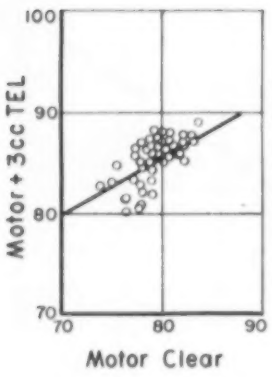


Figure 13. Motor method susceptibility

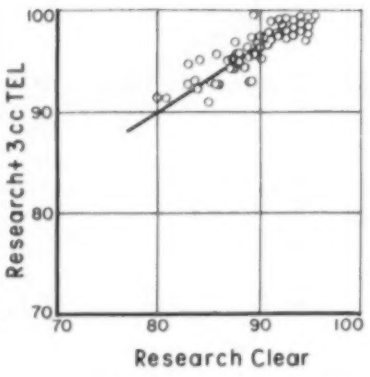


Figure 14. Research method susceptibility

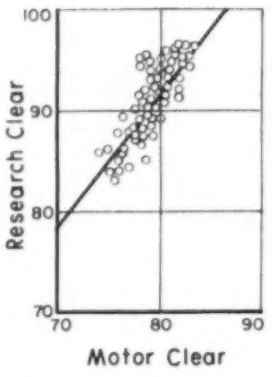


Figure 15. Clear sensitivity

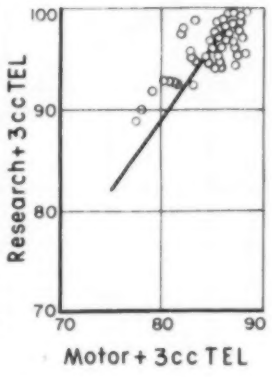


Figure 16. Leaded sensitivity

(5) catalytic polymer gasoline . . .

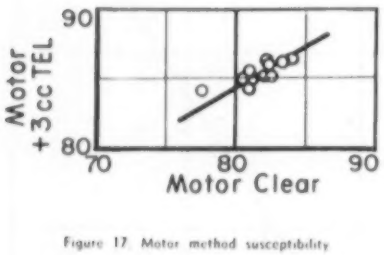


Figure 17. Motor method susceptibility

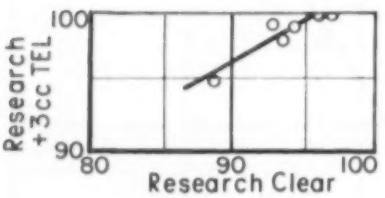


Figure 18. Research method susceptibility

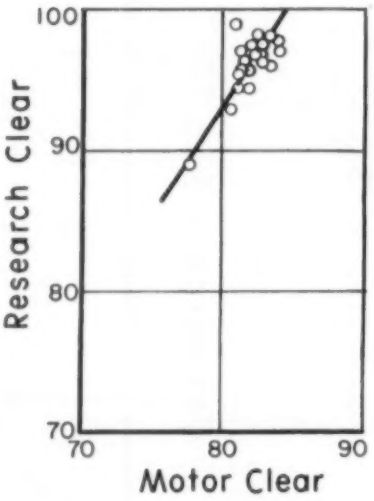


Figure 19. Clear sensitivity

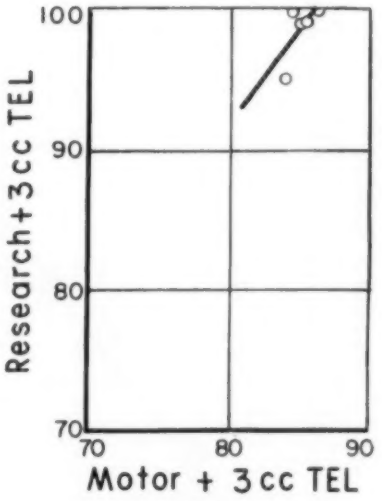


Figure 20. Leaded sensitivity

shown as Figures 17, 18, 19, and 20.

Composite Curves—For ready comparison, the curves for the five blend stocks have been combined for each of the four sets of coordinates in Figures 21, 22, 23, and 24.

Figure 25 is a plot of motor number versus research number of gasolines, both regular and premium, marketed in the past eight years. These data were taken from the periodic surveys published by the Bureau of Mines[73] and by the E. I. du Pont Company[72] and are averages for the whole United States for the period covered by each survey. Again a straight line has been drawn through the points though there is some indication of an upward curving trend (acceleration of sensitivity with increase in motor number). This would be a natural consequence of the demand for increased sensitivity brought on by the upward trend in compression ratio of the automobile engine.

On this same chart, motor and research number require-

all five blending stocks . . .

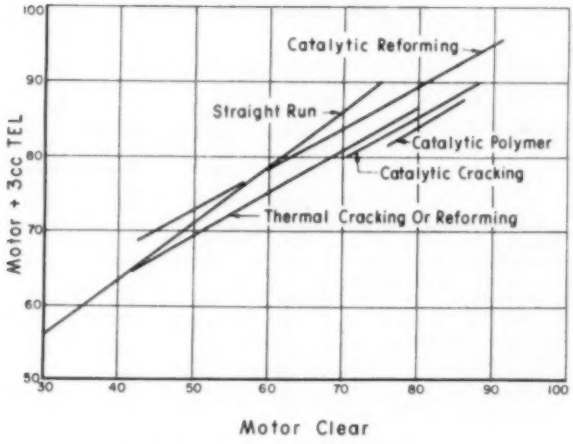


Figure 21. Motor method susceptibility

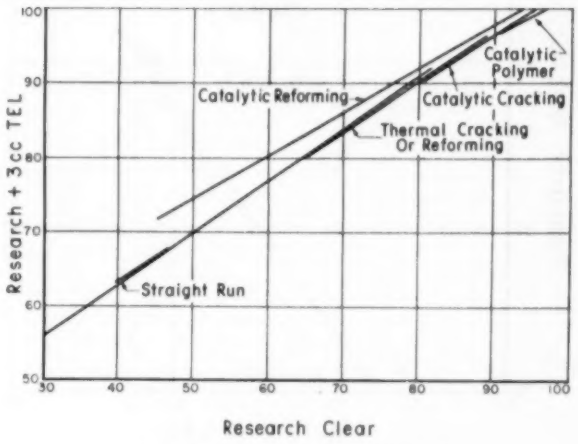


Figure 22. Research method susceptibility

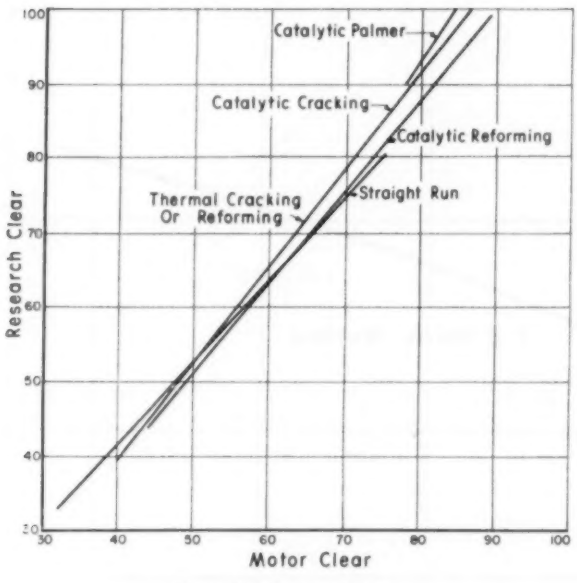


Figure 23. Clear sensitivity

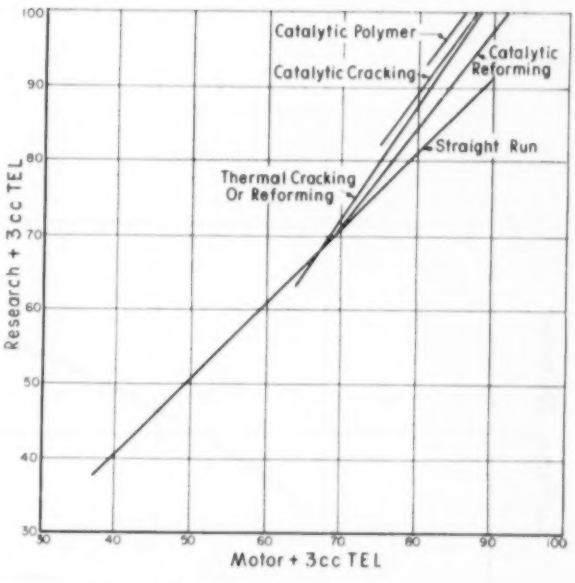


Figure 24. Leaded sensitivity

ments have been indicated for several compression ratios. These data have been taken from the paper by Scott, Tobias, and Haines.[70] The data indicate that research number requirement increases more rapidly with compression ratio than does the motor number requirement. Research number, therefore, becomes limiting and the allowable fuel sensitivity increases with compression ratio.

Auxiliary Curves—To facilitate the extrapolation of octane numbers above 100 on both the motor method scale and the research method scale, the correlation of Deters[61] was used and is reproduced here as Figure 26.

A series of charts were prepared for several series of hydrocarbons in the manner outlined above for the refinery stocks. All the data for these curves were taken from the comprehensive review by Lovell.[65] Curves were drawn for paraffins; mono-olefins; naphthenes and saturated bicyclics; and aromatics, aryl-olefins, and un-

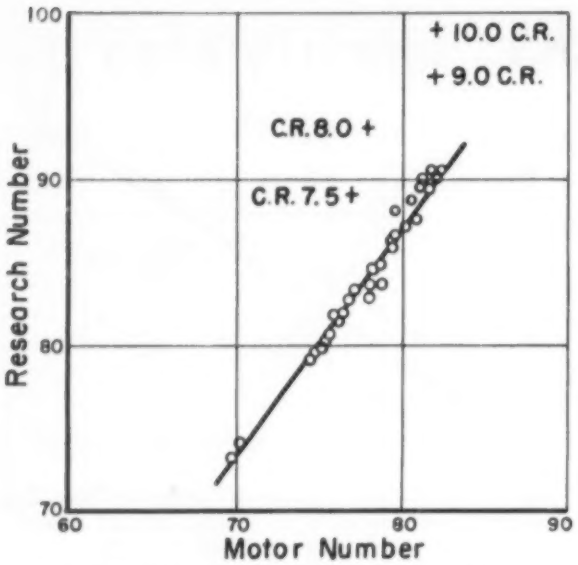


Figure 25. Sensitivity of gasoline marketed in the past eight years

TABLE 1

Number of Samples Represented on Each of the Indicated Plots

	Motor Clr. vs. Motor +3cc TEL	Research Clr. vs. Res. +3cc TEL	Motor Clr. vs. Research Clr.	Motor +3cc TEL vs. Res. +3cc TEL
Straight Run	53	78	51	51
Catalytically Reformed	81	152	85	78
Thermally Cracked or Reformed	34	23	72	23
Catalytically Cracked	78	102	104	97
Catalytic Polymer	12	8	18	7
Paraffins	35	31	38	31
Mono-olefins	27	25	37	25
Saturated Cyclics	24	24	25	24
Unsaturated Cyclics	17	14	21	14

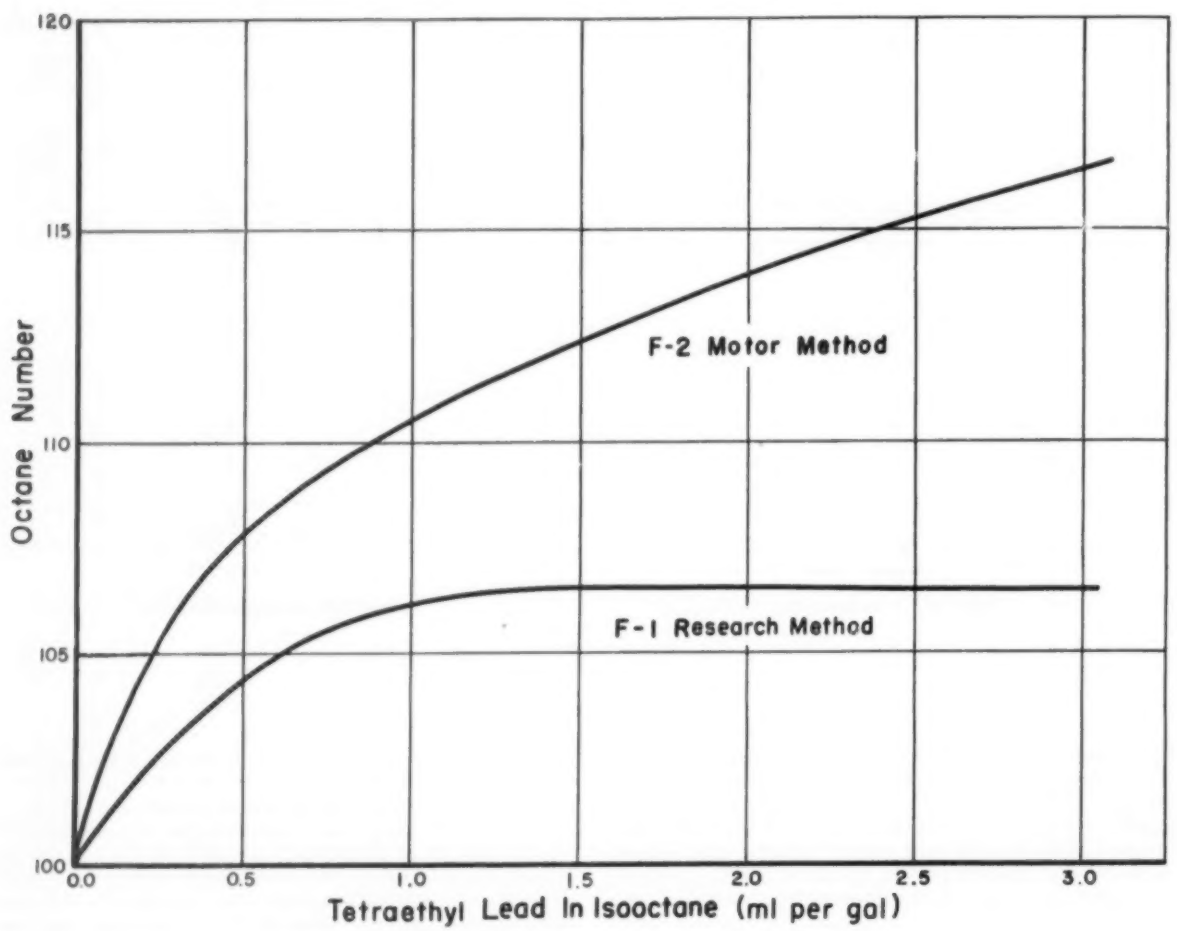


Figure 26. Octane numbers above 100 were extrapolated by this correlation

hydrocarbon classes . . .

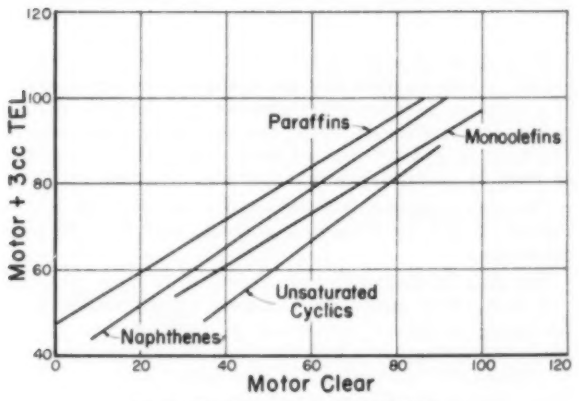


Figure 27. Motor method susceptibility

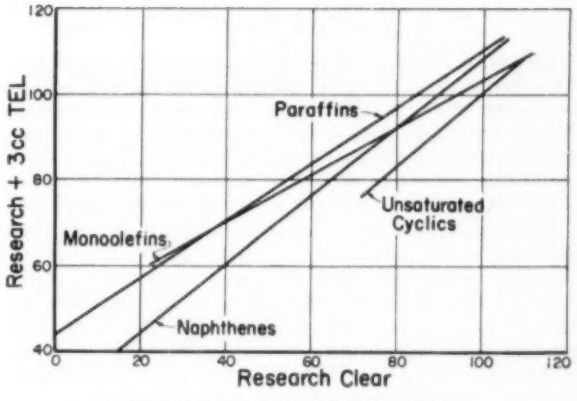


Figure 28. Research method susceptibility

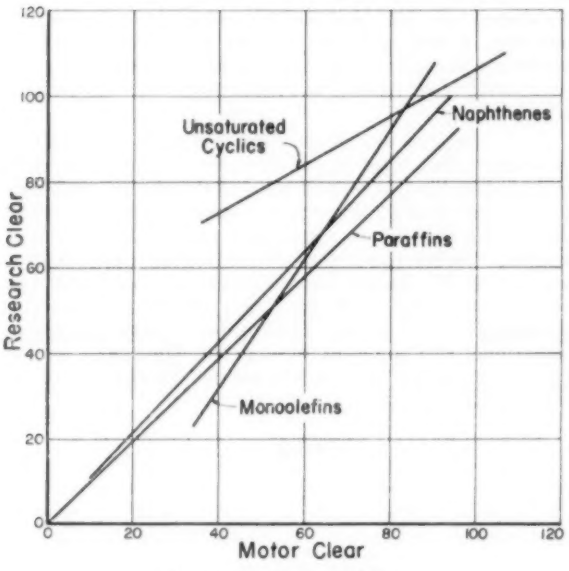


Figure 29. Clear sensitivity

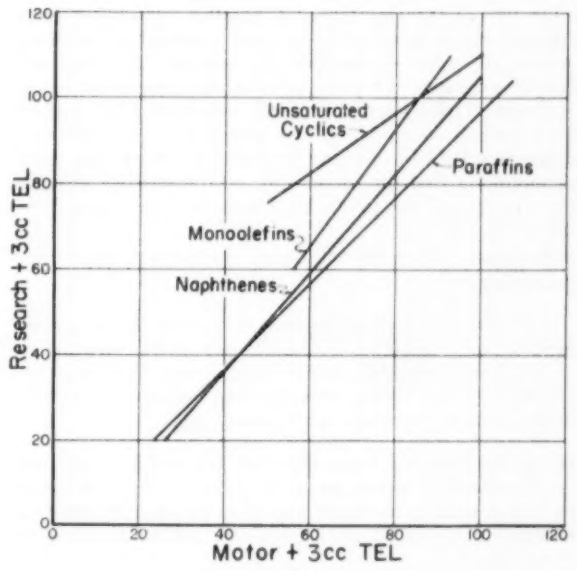


Figure 30. Leaded sensitivity

saturated bicyclics. The individual curves are not reproduced here, but composite charts for the four sets of coordinates appear as Figures 27, 28, 29, and 30.

The references employed in this study have been grouped according to stock designation for the convenience of the reader. The number of samples represented on each of the curves is summarized in Table 1.

No attempt has been made to determine the relative merits of the various correlations of laboratory octane ratings with road or performance ratings. It was simply assumed that for some time laboratory tests will continue to be the refiner's index of motor fuel quality and that the research method and the motor method will be the tests used for this purpose for the immediate future.

In this regard, it is desirable that whenever practicable the refiner determine and report complete sensitivity and susceptibility data on pilot-scale and plant-scale tests of all reforming and cracking studies.

Also, no attempt has been made to correlate blending characteristics of the various stocks. This more difficult problem could perhaps be approached in the same manner as was employed in preparing the present set of charts. Such a study would be of more direct benefit to the refiner as he is primarily interested in the ultimate blends which can be made from his stocks for marketing. However, the charts presented here will be useful in making the indicated conversions and are the only means available for expanding the octane information on tests where insufficient data were obtained—due to lack of sufficient sample, change in emphasis on type of octane test, or other reason—and the samples are no longer available for further testing. And, it is likely that road performance ratings will continue to be correlated in terms of research and motor numbers.

how reforming relates . . .

YIELD-OCTANE correlations have been developed for both thermal and catalytic reforming. These correlations enable the refiner to refer to some standard octane number the different qualities of gasoline obtained from any given cracking stock by different cracking severities. This in turn enables the refiner to determine optimum cracking levels of his various cracking stocks for given market situations.

Faced with fluctuating demands for finished products, accompanied by fluctuations in market prices, the refiner may find occasionally that it is more profitable to crack some of these products rather than to market them as such. This applies primarily to middle distillates and residual fuels. He is then confronted with the problem of how severely to crack each stock, since quality and yield of gasoline produced vary with the nature of the charge stock and the degree of cracking. Assuming the availability of the necessary yield-octane data for cracking the desired stocks, the next requirement is to be able to refer the various qualities of gasolines produced from different cracking severities to some standard or reference quality in order to evaluate the ultimate products and finally determine the point of maximum dollar yield, or optimum cracking level. This last requirement can be met by assuming reforming of the gasoline to the reference octane level if the gasoline produced is below this value or assuming that the increase in octane number was due to reforming if the produced octane number is above the reference level.

Sachanen makes the following observations on thermal reforming:[69]

"The yield of reformed gasoline of a given octane number depends upon the initial octane number of the naphtha, decreasing with decreasing initial octane rating. Vice versa, the higher the initial octane rating the higher the octane number of the reformed gasoline at the same yield."

It can be inferred from this that the yield of gasoline from reforming decreases as a given stock is reformed to higher octane numbers and that the rate of decrease becomes more rapid as the octane number produced becomes higher.

Report TML-3 of the Technical Advisory Committee for the Petroleum Industry War Council[3] established that the octane improvement of nominally 400 F. end-point stocks is a function of the octane number of the feed stock and is independent of any other property of the feed stock, such as characterization factor. The yield-octane relationships in TML-3 were correlated in terms of dry gas yield (weight percent of propane and lighter) with coil outlet pressure as a parameter. This is not a convenient basis for the type of problem outlined here, so an attempt was made to find some more suitable method of correlation.

Correlation Development—A series of charts have been developed which define completely the yield-octane relationships for catalytic and thermal reforming and for both motor and research octane numbers. These correlations were based on three assumptions. First, it was assumed that the yield-octane relationship was independent of operating conditions. Second, it was assumed that a gasoline of any given quality could have been obtained from a stock of some lower quality by reforming. And finally, it was assumed that the instantaneous degradation of a stock in a reforming operation is a function solely of the octane level at which the reforming takes place. The term degradation is used here as the rate of decrease of yield of gasoline per unit increase in octane number.

The same technique was employed in making both correlations. It will be described in detail here for catalytic reforming.

The data employed in the catalytic reforming correlation were taken only from literature reports on the new reforming processes announced in the last four years (those which employ a hydrogen-rich recycle gas stream). A preliminary attempt at a correlation including data from other types of catalytic reforming processes demonstrated that these other processes fall into a different yield-octane category, so they have not been considered in the present correlation. The processes which have been considered are not identified by name as it is not the intention of this paper to compare the various catalytic reforming processes with one another, but rather to compare catalytic reforming, as restricted above, with thermal reforming.

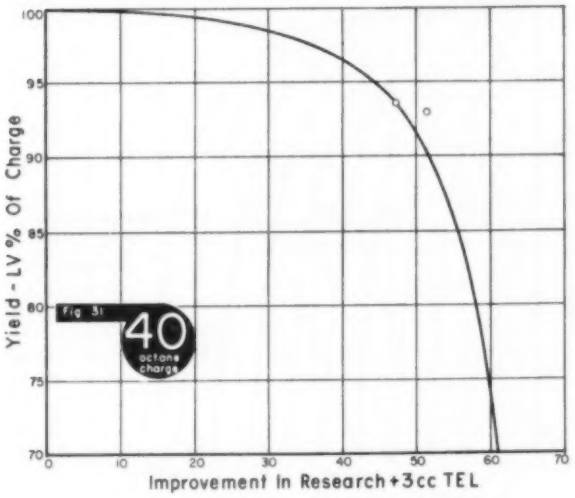
First, the data available in the literature on catalytic reforming (Ref. 5-28, 60 and 74) were grouped according to leaded research octane number of the charge stock into groups separated by five octane number intervals. For the data within each group, the improvement in leaded octane number (leaded number of the reformate minus leaded number of the charge) was determined for each test and plotted versus the corresponding yield of reformate on the chart for that group. The resultant charts are reproduced here as Figures 31 through 38. The charge octane range and number of tests represented on each chart are tabulated in Table 2.

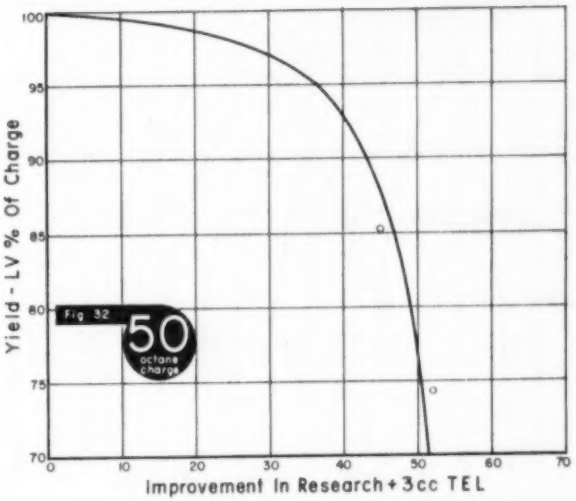
TABLE 2

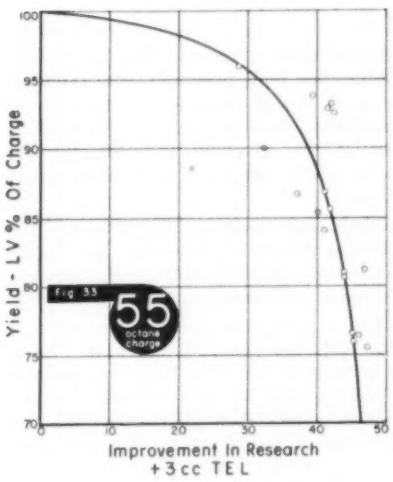
FIGURE NUMBER	Nominal Charge Octane	Actual Range of Charge Octane	Number of Tests Represented
31	40	41.2	2
32	50	49.7	2
33	55	52.8–55.8	19
34	60	59.5–62.0	21
35	65	63.0–67.0	33
36	70	68.4–72.1	24
37	75	73.0–76.6	39
38	80	77.9–80.2	9

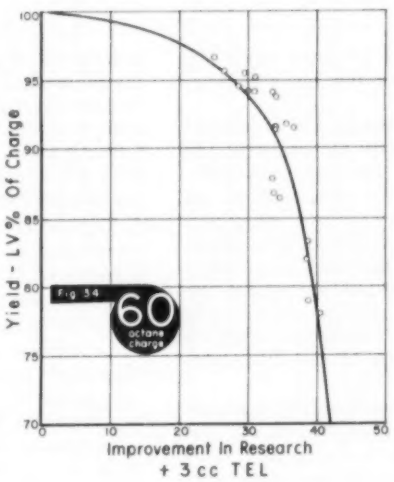
The line drawn on each chart does not necessarily best represent the data on that chart, but is intended to be the line best representing that data which is consistent with the lines on the other charts. This was accomplished by first preparing Figure 39 from curves drawn tentatively on Figures 31 through 38. The lines on Figure 39 were smoothed and spaced, then checked against the corresponding curves on Figures 31 through 38. In this manner, the final curves were derived. In considering the closeness with which the individual lines represent the corresponding data, it should be borne in mind that in most cases the points represent a wide range of charge octane numbers as shown in Table 1. Also, these charts were constructed without regard to operating conditions such as, space velocity, recycle gas ratio, percent hydrogen in the recycle

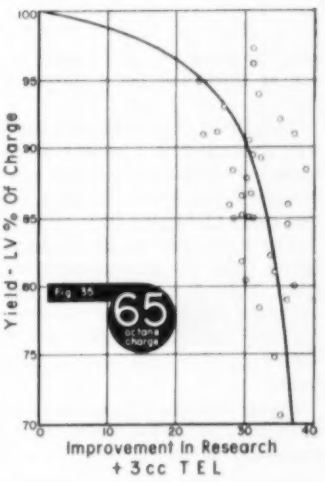
. . . octane improvement and yield

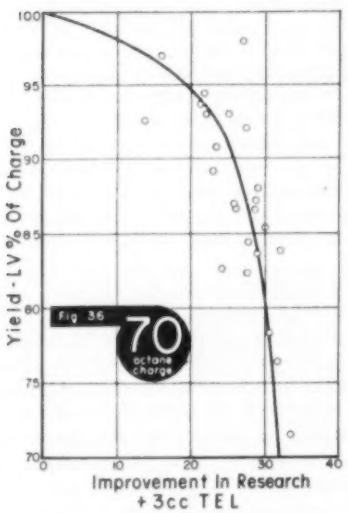


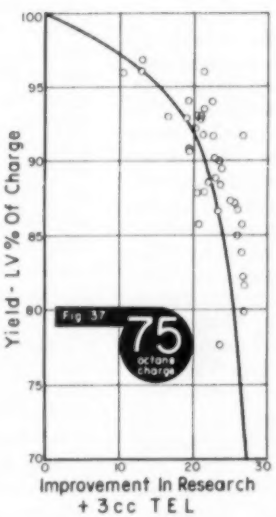


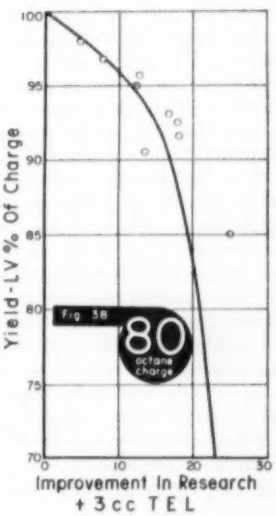












by catalytic reforming . . .

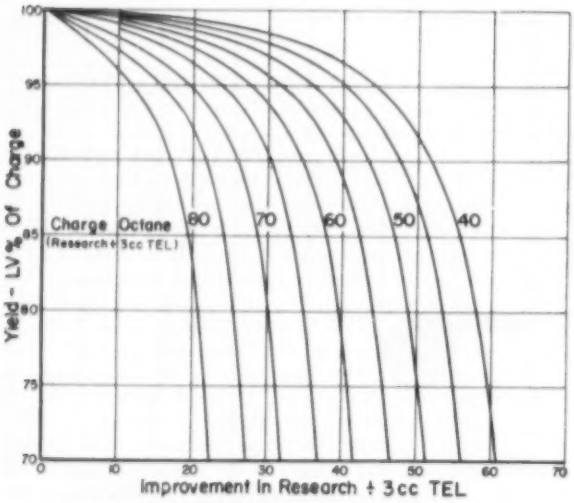


Figure 39. Improvement in leaded research number versus yield of gasoline.

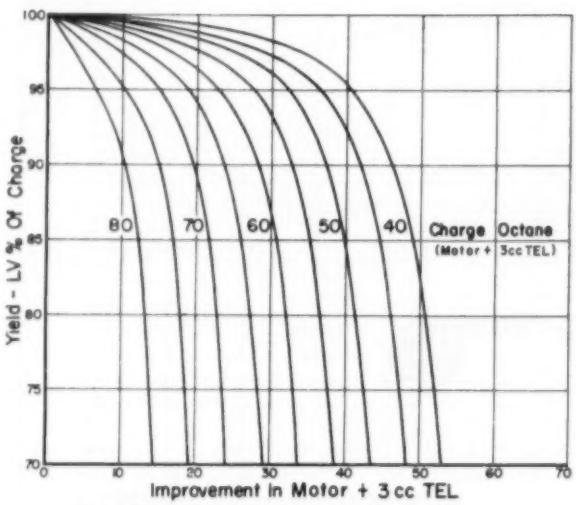


Figure 40. Improvement in leaded motor number versus yield of gasoline.

gas, temperature, and catalyst. And in many cases the charge stock was not a full-range gasoline, but a selected cut.

To extend the usefulness of the correlation, Figure 39 was converted to a motor octane basis by means of the leaded sensitivity curves for straight run and catalytically reformed gasolines (Figures 4 and 8) and is shown on this basis as Figure 40.

The procedure outlined above was employed in correlating data on thermal reforming. The data were taken from TML-3[3] and TML-8.[4] The separate curves for the different charge octane numbers are not reproduced here, but the combined curves for both motor and research octane numbers are shown as Figures 41 and 42 respectively.

Figure 41 was derived first and then converted to Figure 42 using the leaded sensitivity curves for straight run and thermally reformed gasolines (Figures 4 and 12). This operation was again necessary since the test data were generally reported on the basis of only one octane rating method, in this case the motor method.

One major difference will be noted in the manner of plotting the curves for thermal reforming as compared with catalytic reforming. In the case of thermal reforming, yield of reformate is plotted versus octane number of reformate. For catalytic reforming, yield is plotted versus improvement in octane number of reformate over charge. This was done to provide a better spreading of the lines on the catalytic reforming plot and is necessitated by the inherent difference between the yield-octane relationships of the two processes. At a 70-percent yield, there is only 1½ octane numbers spread in either research or motor octane number of reformate from catalytic reforming of 40 to 80 leaded octane number charge stocks. While at the same yield by thermal reforming, there is a 9 motor number spread and an 11 research number spread. The type of plot used for thermal reforming would be more convenient for catalytic reforming if a good separation of the lines would be realized since octane number of reformate is given directly by such a plot.

The data employed in both correlations—thermal and catalytic—were almost entirely for reforming of straight run charge stocks, though there were some data on reforming of cracked naphthas for both processes. The range of characterization factor of charge stock was essentially the same for both correlations: 11.5 to 12.2 for thermal reforming and 11.5 to 12.3 for catalytic. It is thought that the correlations can be safely employed for mild reforming of cracked naphthas.

Figures 31 through 38 for catalytic reforming and the corresponding charts for thermal reforming (not reproduced here) appear to substantially confirm the assumption that the yield-octane relationships are independent of operating conditions.

As a check on the self-consistency of the final curves, Figures 39 through 42, and of the other basic assumptions (a gasoline of any given quality could have been obtained by reforming a stock of some lower quality and that the instantaneous degradation of a stock in a reforming operation is a function solely of the octane level at which the reforming takes place), Figures 43 and 44 were prepared.

The data on these charts were obtained in the following manner. The lines on Figures 39 through 42 were differentiated graphically by reading the slope of each line at several points. Each slope was then multiplied by the ratio of the volume of the original charge to the volume of liquid existing at the point where the slope was measured. This product is the instantaneous rate of disappearance of liquid product per unit increase in octane number of the liquid. These values are plotted on Figures 43 and 44, and define single lines fairly well considering the fact that they are based on unsmoothed, graphical differentials.

Starting with any octane number, any one of these curves can be integrated to produce a curve coincident with the curve for the same charge octane number on the corresponding chart among Figures 39 through 42. In this manner, Figures 39 through 42 could be reproduced. The only advantage in doing this would be that all of the data would be employed in obtaining each line on the final chart. However, it would have the disadvantage of introducing the errors incurred in the graphical differentiation and integration.

The technique outlined for deriving Figures 43 and 44

by thermal reforming . . .

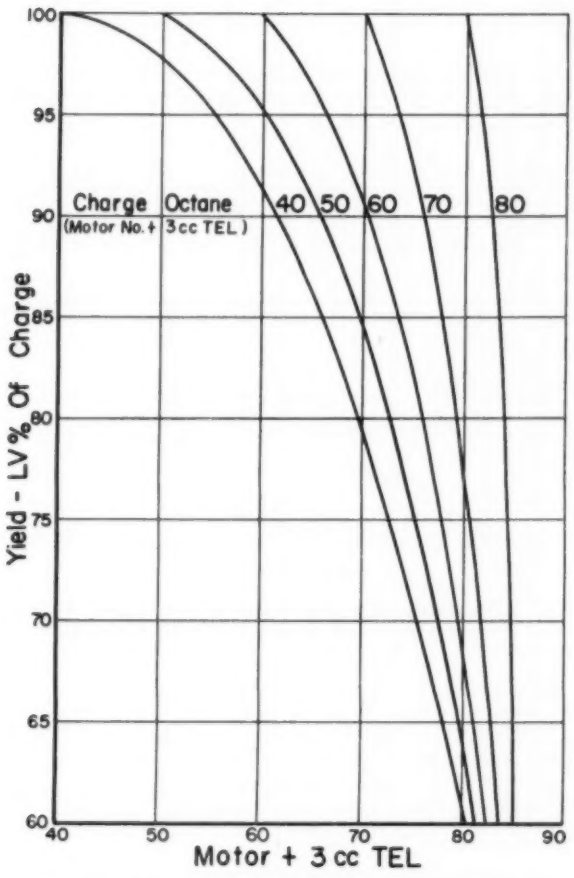


Figure 41. Leaded motor number versus yield of reformate.

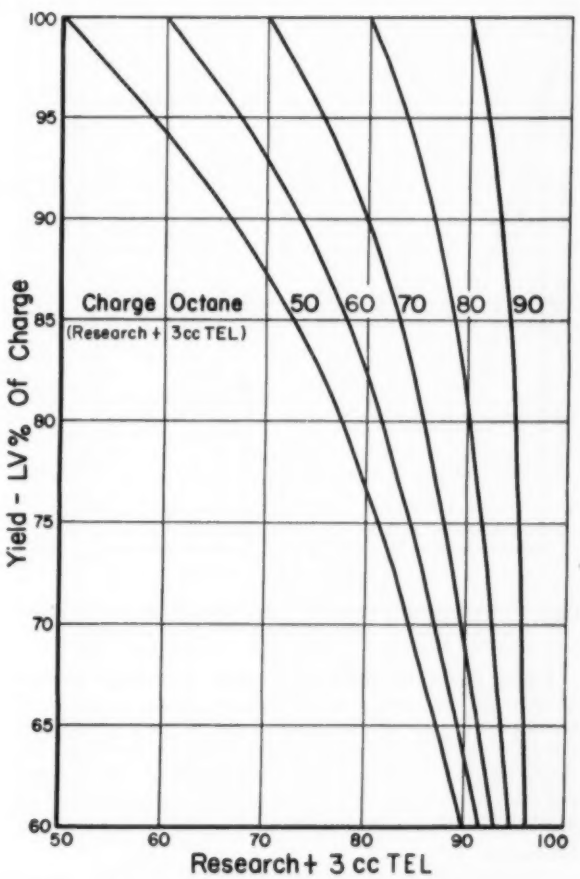


Figure 42. Leaded research number versus yield of reformate.

does not take into account the effect on yield or octane number of the presence of the coexisting gases and coke, but this effect is probably slight.

From Figures 43 and 44 it appears impractical to attempt to exceed 85 leaded research number or 75 leaded motor number by thermal reforming and 95 leaded research number or 85 leaded motor number by catalytic reforming. Also, it appears next to impossible to exceed 94 Research (83 Motor) by thermal reforming and 105 Research (96 Motor) by catalytic reforming. These conclusions are fairly obvious without any consideration of economic factors or making any comparisons between the two processes.

To permit the estimation of yields of materials boiling outside the gasoline boiling range, Figures 45 through 48 have been prepared. The products selected for this purpose were ethane-and-lighter, propane, and butane. For thermal reforming it was necessary to have a heavier-than-gasoline product designated as "tar." Octane improvement was used as a basis for correlating these yields. Yield of ethane-and-lighter is shown throughout as weight percent of charge. Propane is given as weight percent for catalytic reforming and liquid volume percent for thermal reforming. Butane and tar yields are shown as liquid volume percents in every case.

These charts are based on fewer data than are the gasoline yield curves. As a result, the octane improvement criterion is a necessary oversimplification of the actual yield relationships. Therefore, these charts can not be used with the same degree of assurance as the gasoline yield charts. However, in most cases the resultant yields will be quite small and comparative figures will be sufficiently accurate for most purposes.

In the case of thermal reforming, the ethane-and-lighter can be assumed to have a net heating value of 20,300 Btu per pound. In the case of catalytic reforming, this value will vary widely depending on the hydrogen and hydrogen sulfide content of the gas. On a hydrogen sulfide free basis, a value of approximately 40,300 Btu per pound appears reasonable. However, on a volume basis this value will be less than 550 Btu per cubic foot which means difficulties will be encountered when an attempt is made to utilize this gas in a system designed for 1000 Btu gas or higher. As it contains between 70 and 95 mole percent hydrogen, this gas is more valuable as a source of hydrogen when it can be utilized readily or sold easily than it is as a source of Btu's.

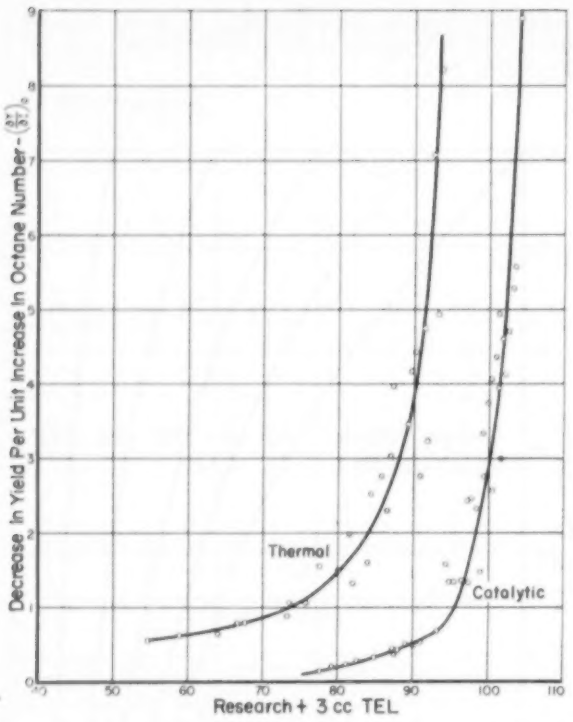


Figure 43. Instantaneous decrease in yield per unit increase in leaded motor number for both catalytic and thermal reforming

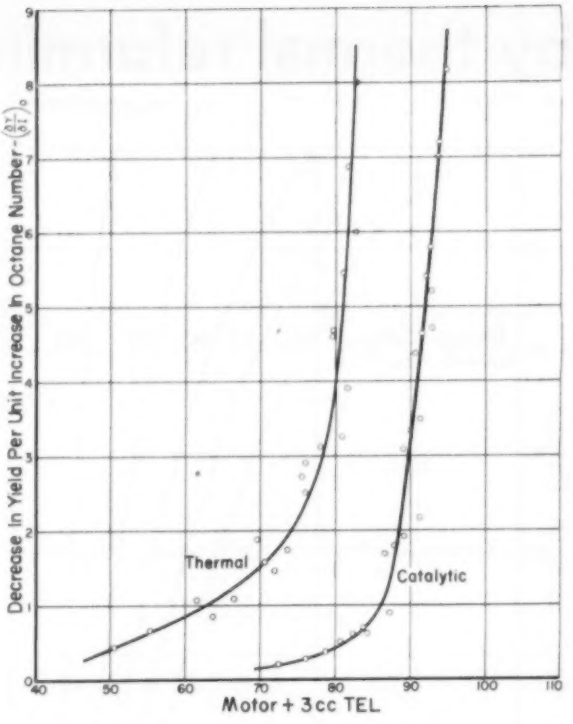


Figure 44. Instantaneous decrease in yield per unit increase in leaded motor number for both catalytic and thermal reforming

Using the Correlations—Figures 39 through 42 and 45 through 48 make available to the refiner a means of accomplishing the second step of the original problem—that of being able to refer the various qualities of gasoline produced from different cracking severities to some standard or reference quality. This can best be explained by means of illustrative examples.

Example 1.

Problem: Pilot plant thermal cracking of a certain diesel fuel gave the following yield-octane data for butane-free gasoline.

Test	1	2	3	4	5	6
LV % Gasoline	27.9	30.2	32.2	39.1	39.9	40.9
ClearMotor No.	58.2	58.5	60.0	65.0	66.7	70.2

All these tests are to be referred to a standard leaded (3 cc) Motor octane number of 78.

Solution: First, the given clear octane numbers must be converted to leaded numbers. This can be done by means of Figure 9.

Test	1	2	3	4	5	6
Leaded Motor No.	74.3	74.5	75.4	78.1	79.1	81.2
Improvement	3.7	3.5	2.6	—0.1	—1.1	—3.2

It is seen that the gasolines from Tests 1, 2, and 3 are lower in octane number than the standard and can be reformed to that standard with a decrease in yield from that realized in the pilot plant tests. Tests 5 and 6, on the other hand, produced gasolines of higher quality than the standard and are, therefore, equivalent to a higher yield of standard quality gasoline than that realized in the pilot plant tests. There will be no correction for Test 4.

The yield correction is made by reading from Figure 40 for catalytic reforming or Figure 41 for thermal reforming the yield of 78-octane material from reforming the gasolines from Tests 1, 2, and 3. In the case of Tests 5 and 6, the yield of material of the actual octane which could be obtained from a 78 octane number charge stock is read from the same figure.

Test	1	2	3	4	5	6
Yield by Thermal Reforming	93.2	93.1	94.7	100	$\frac{100}{.975}$	$\frac{100}{.910}$
Pilot Plant Yield Corrected for Thermal Reforming	26.0	28.1	30.5	39.1	40.9	44.9
Yield by Catalytic Reforming	99.2	99.1	99.3	100	$\frac{100}{.997}$	$\frac{100}{.991}$
Pilot Plant Yield Corrected for Catalytic Reforming	27.8	29.9	32.0	39.1	40.0	41.3

In addition, the corresponding yields of materials boiling outside the boiling range of gasoline are read from Figure 46 for catalytic reforming or from Figure 48 for thermal reforming.

For thermal reforming:

Test	1	2	3	4	5	6
Wt % C_3–	0.4	0.4	0.3	0	negl.	—0.4
LV % C_3	1.1	1.1	0.7	0	—0.1	—0.9
LV % C_4	0.9	0.9	0.6	0	—0.1	—0.8
LV % Tar	0.1	0.1	0.1	0	negl.	—0.1

For catalytic reforming:

Test	1	2	3	4	5	6
Wt % C_2	0.3	0.3	0.2	0	—0.1	—0.3
Wt % C_3	0.1	0.1	0.1	0	negl.	negl.
LV % C_4	0.2	0.2	0.1	0	negl.	negl.

The negative figures for Tests 5 and 6 are yields to be subtracted from the yields of corresponding materials from the pilot plant tests, since if the cracking operation had been conducted to produce 78-octane gasoline, the yields of these materials would have been less by the amounts indicated in the tables. These values are based on the 78-octane gasoline as 100 percent. In the other tests, the indicated values are based on the gasoline produced in the pilot plant tests as 100 percent and are additional yields which would be realized in reforming the given gasolines to 78 octane number.

These yield figures, now corrected to the same quality, can be used in making an economic study of the realization from cracking this diesel fuel compared with marketing it as such. In this series of tests, the yields of mate-

other yields in catalytic reforming . . .

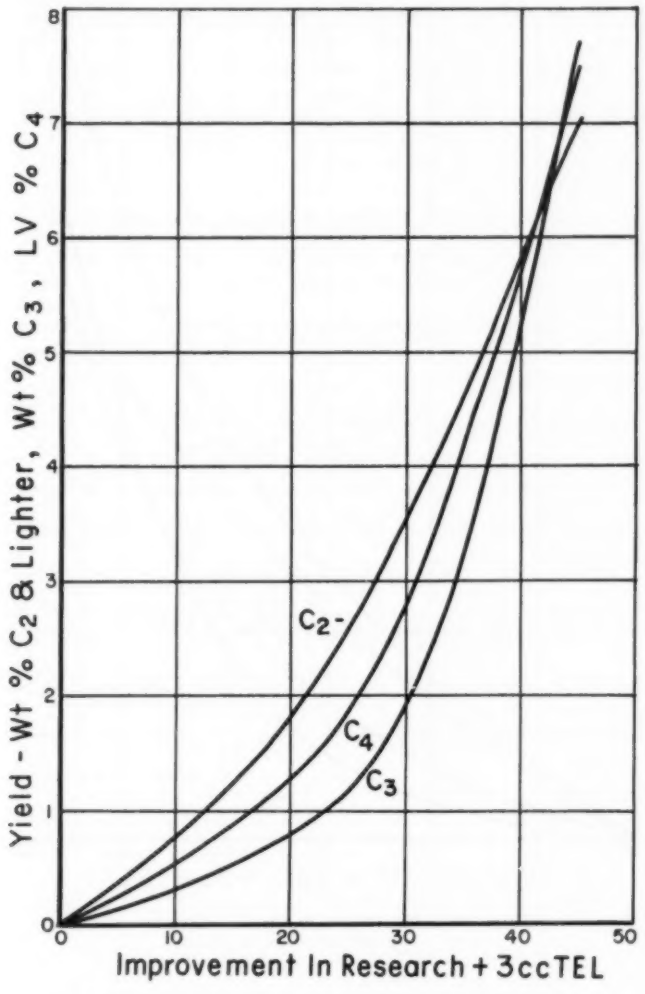


Figure 45. Yields of butane and lighter versus improvement in research number

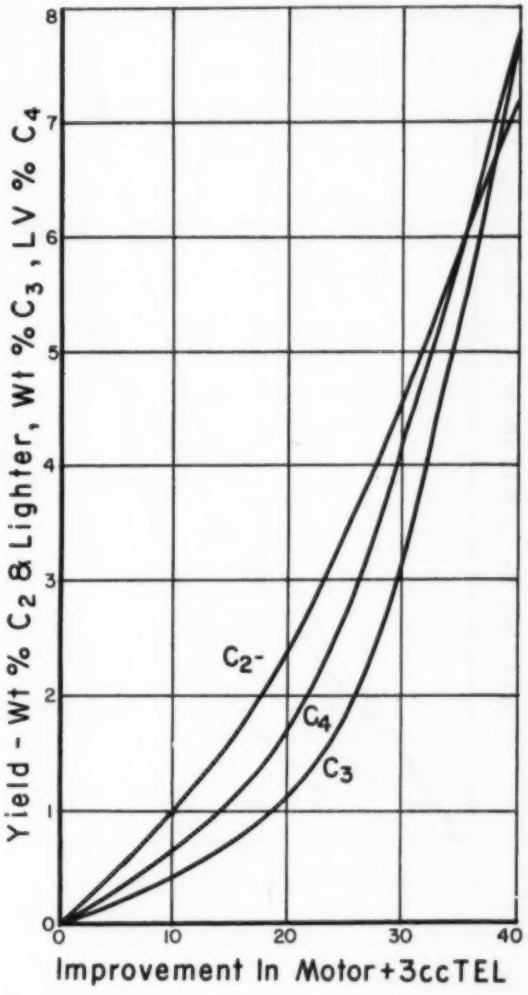


Figure 46. Yields of butane and lighter versus improvement in motor number

rials boiling outside gasoline range can be neglected for most purposes.

Example 2.

Problem: The following debutanized natural gasolines are being considered for purchase.

Gasoline	1	2	3	4	5
Clear Research No.	59.4	39.9	43.5	36.6	46.5

Assuming these gasolines to be equal in all other respects, compare them on the basis of their equivalence to 85 leaded research number.

Solution: Again, the given clear numbers must be converted to leaded numbers. This can be accomplished by means of Figure 2.

Gasoline	1	2	3	4	5
Leaded Research Number	76.7	63.0	65.5	60.7	67.6
Improvement to 85	8.3	22.0	19.5	24.3	17.4

It is seen that all of the gasolines have leaded numbers below the standard. Referring to Figure 39 for catalytic reforming or Figure 42 for thermal reforming, the yield of 85 octane number reformate which could be realized from each stock is readily obtained.

Gasoline	1	2	3	4	5
Yield—Thermal	88.8	76.0	77.7	74.7	79.6
Relative Value	1.000	.856	.875	.841	.896
Yield—Catalytic	97.6	96.3	96.4	96.1	96.5
Relative Value	1.000	.987	.988	.985	.989

To facilitate the final decision regarding these gasolines, the value relative to gasoline number one has been included for both thermal and catalytic reforming.

The yields of other materials in this example are obtained from Figure 45 for catalytic reforming or Figure 47 for the thermal reforming.

For thermal reforming:

Gasoline No.	1	2	3	4	5
Wt % C_2-	1.0	3.4	2.8	3.9	2.5
LV % C_3	2.3	6.4	5.6	7.3	4.9
LV % C_4	2.0	5.5	4.8	6.1	4.3
LV % Tar	0.5	2.4	1.8	3.1	1.4

For catalytic reforming:

Gasoline No.	1	2	3	4	5
Wt % C_2-	0.6	2.1	1.7	2.4	1.5
Wt % C_3	0.2	0.9	0.7	1.1	0.6
LV % C_4	0.4	1.5	1.2	1.7	1.0

other yields in thermal reforming . . .

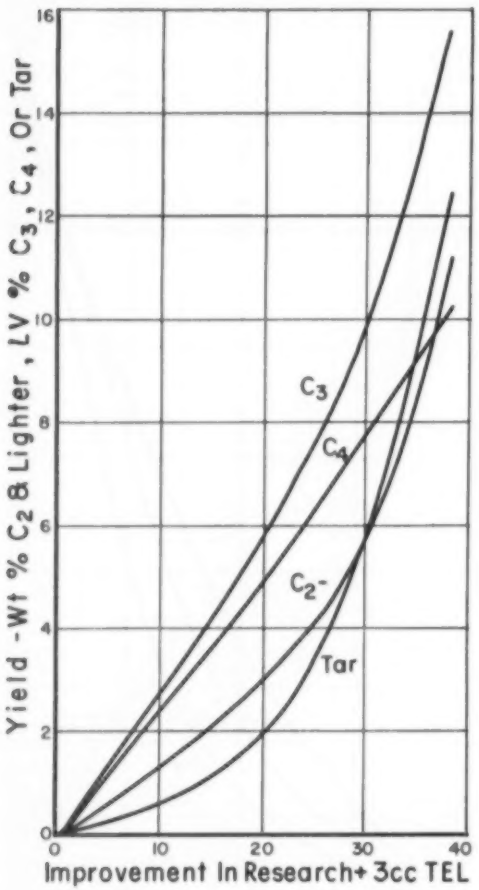


Figure 47. Yields of lighter and heavier than gasoline versus improvement in research number

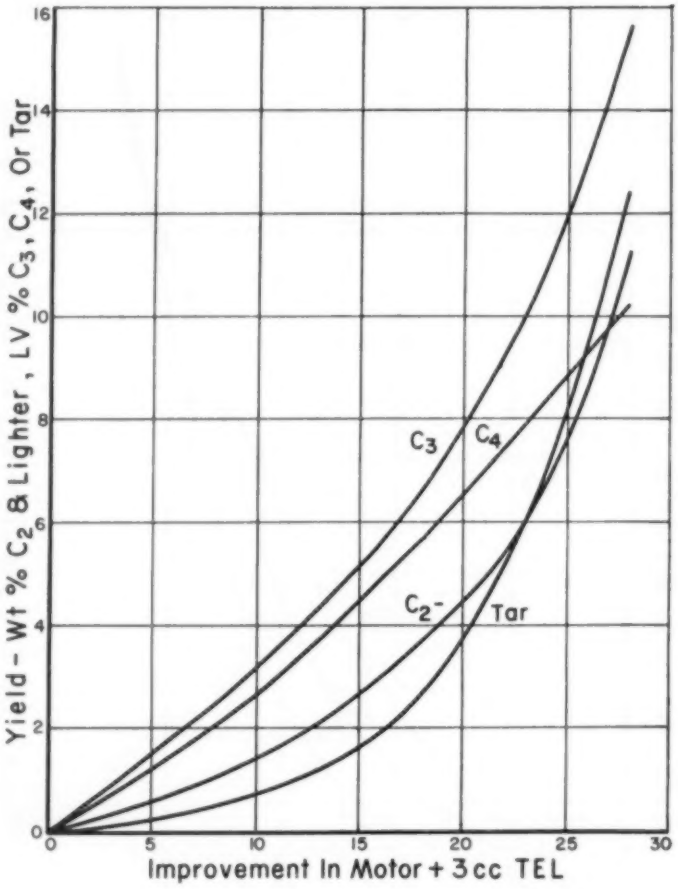


Figure 48. Yields of lighter and heavier than gasoline versus improvement in motor number

These yields are to be evaluated and added to the gasoline value.

The present correlations can be used in economic studies to determine optimum cracking severity—where TEL is used in varying amounts to bring the different qualities to the same level—by means of the susceptibility charts, Figures 6 and 10, and an Hebl-type of ethyl blending chart.[52] This will be illustrated by the following example.

Example 3.

Problem: A naphtha with a leaded Research number of 65 is to be brought to a Research number of 90 by the optimum combination of ethylizing and reforming.

Solution: No consideration will be given here to costs. The sole concern will be the yields of gasolines and the accompanying TEL requirements. This problem will be approached first using catalytic reforming, then by thermal reforming. In each case, certain improvements in octane number will be assumed, the corresponding yield determined from the present correlations, the corresponding clear numbers determined by means of Figure 6 or 10 and finally the number of cc of TEL required to bring the particular reformate to a Research number of 90 will be determined by assuming a straight line lead curve on a Hebl chart.

The results for this procedure for catalytic reforming are summarized in Table A.

Results for thermal reforming are as shown in Table B.

TABLE A

Improvement	Yield	Leaded No.	Clear No.	cc TEL to 90
20	96.4	85	67.8	>6
22	95.7	87	71.0	5.1
25	94.3	90	76.2	3.0
26	93.8	91	77.9	2.5
27	93.1	92	79.7	1.9
28	92.3	93	81.3	1.5
29	91.4	94	83.0	1.1
30	90.2	95	84.8	0.7
32	87.3	97	88.3	0.2
35	79.5	100	93.2	Clear is > 90

TABLE B

Improvement	Yield	Leaded No.	Clear No.	cc TEL to 90
21	73.5	86	73.2	>6
22	73.0	87	74.7	6.0
23	70.8	88	76.2	5.0
24	68.1	89	77.7	3.9
25	66.0	90	79.2	3.0
26	63.5	91	80.7	2.4
27	60.8	92	82.2	1.7

Again, the yields of other materials can be read from Figures 45 and 47 for catalytic and thermal reforming respectively. These data taken with product prices, TEL cost, fixed and variable costs, etc. can be employed by the refiner to determine the optimum reforming level for this stock.

Summary—Yield-octane relationships have been derived for both thermal and catalytic reforming and for both motor and research octane numbers. These curves are not exact enough to be used as direct guides to actual operations (i.e.: for the prediction of the exact yield of a given octane to be expected from a given charge stock). However, they can be used to estimate rather accurately the relative yields of various octane numbers from a given stock or stocks, or to estimate the relative yields of a given octane number from various stocks as illustrated in the above examples.

The three basic assumptions were substantiated satisfactorily:

1. The yield-octane relationship is independent of operating conditions. (Figures 31 through 38.)

2. A gasoline of any quality can be obtained by reforming a stock of some lower quality. (Figures 43, 44.)

3. The instantaneous degradation of a stock in a reforming operation is a function of the octane level at which the reforming takes place. (Figures 43, 44.)

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It will pay you to look into the economics of operating an old pump. New pumps like this require less maintenance and power.

When to Replace a Pump

Check the hidden costs. They may run higher than the cost of a modern replacement.

C. E. Cromwell, DeLaval Steam Turbine Company, Trenton, N. J.

DIGGING INTO the economics of operating an old pump could turn up highly profitable information. The appearance of satisfactory performance may be hiding real costs which could very well represent the price of a modern pump, and other appreciable savings, too.

A pump may still be delivering designed capacity and head despite its age. It is this fact, the seemingly satisfactory performance of the pump, that protects its reputation as an "old faithful" from closer scrutiny. Gradual decreasing efficiency is not as noticeable as a sudden breakdown. Nor are power costs looked upon as excessive unless totaled up over a number of years and compared with similar costs for a new pump. Pump manufacturers have come a long way in designing units to reduce over-all operating costs.

Consider a motor-driven pump built in 1928 to handle 2500 gallons per minute against 150 feet total head. When originally built, it had an efficiency of 78 percent requiring an input of 121 brake horsepower. Due to wear and tear, and if no revolving parts have been replaced, it could be expected that the pump in 1953 would have an efficiency of about 74 percent, and would require 128 bhp to deliver the designed capacity and head.

Save 18 bhp—A modern pump for these same conditions could be expected to have an efficiency of 78 percent, requiring 110 bhp. This is a possible saving of 18 bhp. Based on a power cost of 1 cent per kilowatt-hour, savings in power cost for one year (8760 operating-hours) is $1176.

The cost of a new pump or complete unit, and the time it would take to pay for it from the operating-savings gained over old pump are shown here. The following figures are based on 1 cent per kwh, or $.00746 per horsepower. (Add additional costs for freightage and for changing foundation and piping to the total cost figure.)

Price (estimated) of new pump, based, coupling	$1238
Price (estimated) of 125-hp 440-v 1750-rpm motor	1390
Price (estimated) of reduced voltage starter	1170
Total cost of new pump, motor, starter	$3798

Hours per year operation	8760	6500	4000
Savings will pay pump base & coupling in (mos.)	13	17	28
Savings will pay for complete unit in (months)	39	52	84

Even if renewal parts for the 1928 pump could restore its original efficiency of 78 percent it still requires 11

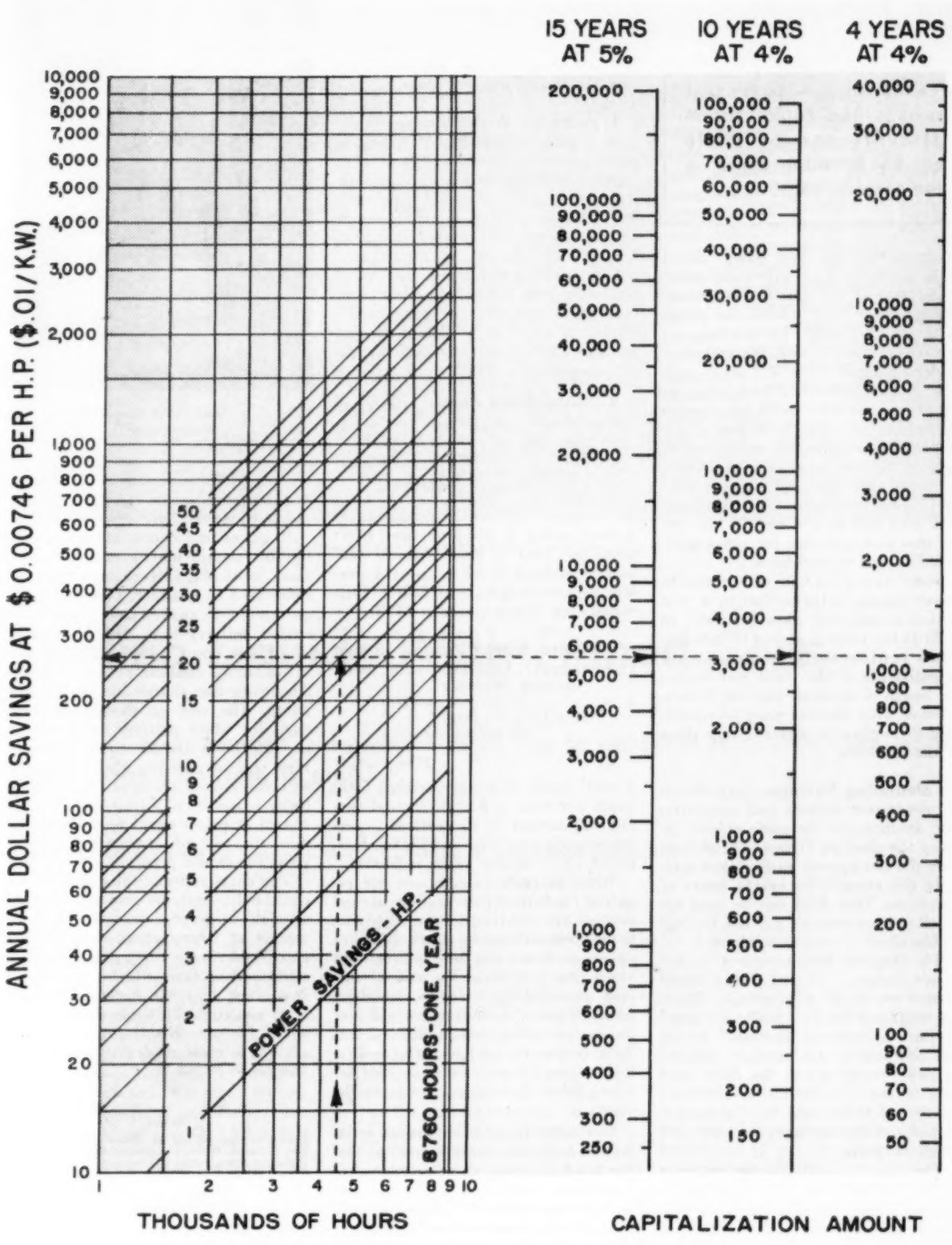

15 YEARS AT 5%
10 YEARS AT 4%
4 YEARS AT 4%
ANNUAL DOLLAR SAVINGS AT $0.00746 PER H.P. ($.01/K.W.)
POWER SAVINGS - H.P.
8760 HOURS-ONE YEAR
THOUSANDS OF HOURS
CAPITALIZATION AMOUNT

FIGURE 1

HOW TO USE THE CHART—Here is an example plotted on the chart. A 1930-model pump has an efficiency of 71.7 percent requiring 100-horsepower motor. A 1954 pump has an efficiency of 78 percent requiring only 92-hp motor. Saving is 8 hp. The pump operates about 4400 hours per year. Find the point where diagonal 8-hp line intersects 4400-hour line. Column at left shows annual saving to be approximately $260. The saving in ten years (considering interest at 4 percent compounded annually) would be about $3200.

Pump Replacement . . .

Calculation of power cost savings and capitalization amounts can be made quickly by using chart on the opposite page.

hp more than the new pump. Based on 8760-hour operation per year, power cost of old unit is $719 more. Depending on how obsolete the pump parts are, they might be relatively expensive, compared with the cost of a modern pump.

If the amount saved each year on power cost were set aside to accumulate interest, the total will then represent an amount that will pay for all or part of the cost of a new unit. If a company's practice is to consider relatively long term write-offs, these savings may well be sufficient to pay for the new unit and also for other additional capital expenditures.

Some operators of central-station power plants believe that in a new station a unit that pays for itself in eight to ten years is a good investment. When replacing old equipment, the expected life of the plant may reduce the length of write-off that can be considered. This premise must be considered throughout industry, regardless of the products.

Calculating Savings—Calculation of power cost savings and capitalization amounts can be made quickly by using the chart in Figure 1. First compute the horsepower savings and multiply the results by yearly hours of operation. This chart can be used for quick approximations and can be read within about 2 percent accuracy.

The diagonal lines represent "horsepower savings." The abscissa shows "hours per year" of operation. Reading vertically up the "hours per year" to the "horsepower savings," to the left ordinate is the "annual savings" in power cost, and to the right ordinate is the "capitalization amount." Shown are three right hand ordinates, each for different interest rates and terms of years.

The chart is based on cost of power at $.01 per kilowatt. If in a particular locality power cost is more or less, simply multiply answer from the chart by the ratio to actual cost; i.e., if the cost is 12 mils per kw, multiply by 1.2; if the cost is 9 mils per kw, multiply by .9.

Examples of Savings—The following examples are taken from records to show what improvements in efficiency have been made and the saving and capitalization amounts are taken from the attached chart.

1. Service Water Pump—Consider a pump installed in 1926 having an efficiency of 70 percent and an input of 28.9 bhp. A modern pump for the same conditions (400 gpm, 200 feet total head) has an efficiency of 79 percent and an input of 25.6 bhp. This is a 3.3 bhp saving. Annual saving if service water pump runs 6000 hours per year is $150. Capitalized in four years at 4 percent interest the total amount is $630. The estimated price of a new pump for these operating conditions is $438.

2. Boiler Feed Pump—400 gpm, 650 total head at 220 F.

year 1930, efficiency
63 percent, 99.5 bhp
year 1953, efficiency
69 percent, 91.0 bhp

8.5 bhp saving

Annual saving if pump operated 8760 hours per year is $560. Annual savings capitalized in 10 years at 4 percent represents a total of $6700. Estimated cost of new pump is $1101.

3. Water Works Pump—15 mgd (10,400 gpm), total head—200 feet.

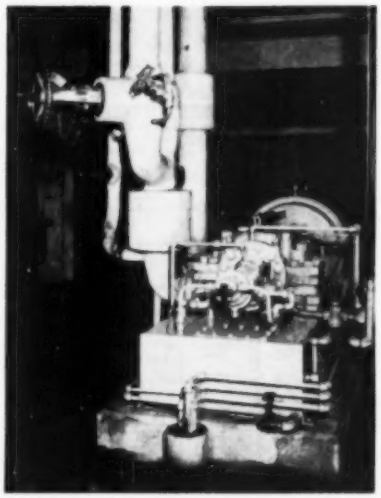
year 1926, efficiency
84 percent, 625 bhp
year 1953, efficiency
89 percent, 590 bhp

35 bhp saving

Annual saving if pump operated 5000 hours per year is $1300. Annual savings capitalized in 15 years at 5 percent represents a total of $28,000. Estimated price of new pump is $4054.

When accurate calculations are required for formal presentation, annual savings are obtained by multiplying horsepower savings by yearly hours of operation x cost per horsepower hour (kwh cost x 0.746). The annual savings divided by a factor, based on terms of years of interest rate will give the capitalization amount. Table 1 lists these factors for various terms and interest rates. These can also be used for terms other than those shown in the chart.

Undoubtedly, plant engineers in industry and municipalities realize that the hidden costs of operating old equipment could very well represent the purchase price of new equipment. But management officials must be shown why the purchase of modern equipment is a wiser investment than the continuing costs of operating old equipment. In some cases, the actual cost factors of operating old equipment are obscured because power costs



Boiler Feed Pump: $560 annual savings (see example at left).

are negligible, where power is obtained as the by-product of some process. Or the unit may be fully depreciated.

If power and depreciation are negligible factors, which is seldom the case, there are still repair costs of some kind to consider. Obsolete parts are more expensive and require extended delivery time. Should production losses occur because of the delay in obtaining obsolete renewal parts, the losses are chargeable to the old pump. The cost of modern renewal parts for which patterns are available and the parts are in stock represent very tangible savings when compared with the cost of obsolete parts. Sometimes a modern pump can be purchased at prices equal to or even less than the cost of extensive renewal parts for an old pump.

The chart and examples shown here could help engineers give management officials a graphic insight into economics of depreciation, deterioration and obsolescence for a particular installation in their plants. They will also show how the higher operating costs entailed by these three factors could be converted into appreciable savings to make modernization pay its own way.

TABLE 1

Annual savings divided by factors in table equals sum including interest accumulated for number of years and interest rate selected.

	Percent Interest Rate/Annum, Compounded Annually				
Years	2	3	4	5	6
2	.49505	.49261	.49020	.48780	.48544
3	.32675	.32353	.32035	.31721	.31411
4	.24262	.23903	.23549	.23201	.22859
6	.15853	.15460	.15076	.14702	.14336
8	.11651	.11246	.10853	.10472	.10104
10	.09133	.08723	.08329	.07950	.07587
12	.07456	.07046	.06655	.06283	.05928
15	.06260	.05377	.04994	.04634	.04296

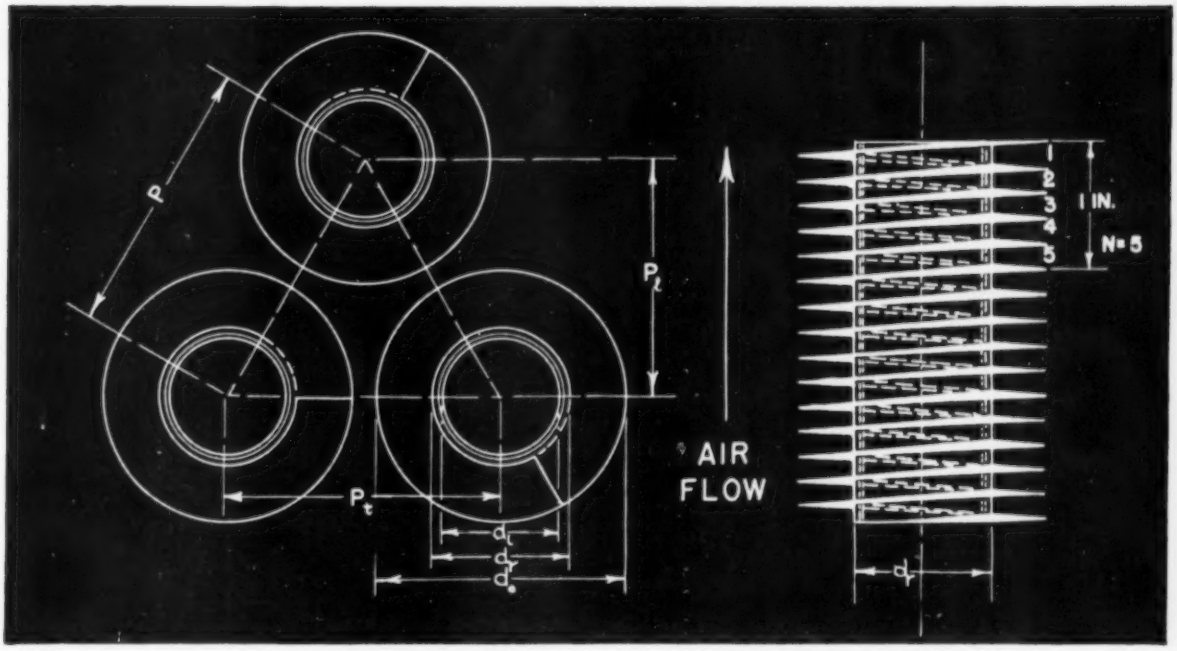


Figure 1. Nomenclature for dimensions of finned tube and tube spacing.

Cooling Liquids With Finned Coils

Heat transfer and pressure drops can be predicted from these correlations based on test data from 30 units.

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AIR PASSING across banks of finned tubes is often employed to cool fluids in fin fan units which replace cooling towers, in radiators for engine coolers and in other applications. Heat transfer and pressure drop data for gases passing over banks of plain tubes have been correlated[1,2] based on the tube diameter, transverse spacing and longitudinal spacing of the tubes. Correlation of similar data for finned tubes involves added variables over those for plain tubes, including fin height, fin spacing, and ratio of fin diameter to root diameter. Data and correlations for air passing across banks of finned tubes have been reported, but no general correlation of this information was available at the time this work was started.[2,3,4,5,6] Schmidt[7] treated the problem of heat transfer and pressure drop during the course of this study.

The data in the literature as well as test data reported from a group of private laboratories were assembled and analyzed. Experimental data on thirty units containing transverse finned tubes with various pitches, tube arrangements, fin heights, fin spacings and tube diameter were available.* The face area of the units varied from 11.6 by 7.5 inches to 24 by 20 feet. There were two types of tubes used, integral fin construction made from copper or aluminum and bi-metal fin construction with aluminum fins and root metal over copper liners. In all cases, heat transfer data were obtained for a series of air velocities passing over the coils with the air being heated.

Two correlations of the data have been made. The first is for air passing across banks of tubes at a specific velocity in feet per minute. In this case it is not necessary to use the properties of air, although it must be recognized that air normally entered the coil at room temperature and was heated up to a temperature not exceeding some 250 F.

Figure 1 shows the nomenclature for describing finned tubes.

Correlations for Air—The data were all reduced to a basis of film coefficients of heat transfer per square foot of outside surface. In many cases fluid was circulated inside the tubes at a series of velocities which could be

* Dimensions of the units tested and example calculations are given in a report "Correlations of Heat Transfer and Pressure Drop for Air Flowing Across Banks of Finned Tubes," Engineering research Institute, University of Michigan, by the same authors.

extrapolated to infinite velocity thereby obtaining the resistance of the metal wall and the outside film. In the cases where steam was condensing inside the tubes it was necessary to assume a condensation coefficient for steam to compute the outside coefficient. The range of outside coefficients in Btu's per (hour) (°F) (square feet outside surface) was 2.8 to 39.6.

Figure 2 shows the heat transfer coefficients for the outside surface as a function of the maximum air velocity in feet per minute. The maximum air velocity is computed from an air density of 0.074 pounds per cubic foot and the minimum cross-sectional free flow area between the tubes. It may be seen from Figure 2 that at a given velocity heat transfer coefficients vary 3 to 1 for the best tubes and their arrangement as compared to the poorest tubes and their arrangement. It might be noted that units 11, 12, and 13 had an in-line arrangement for the tubes. Units 1 and 22 had a single row of tubes while the other units were

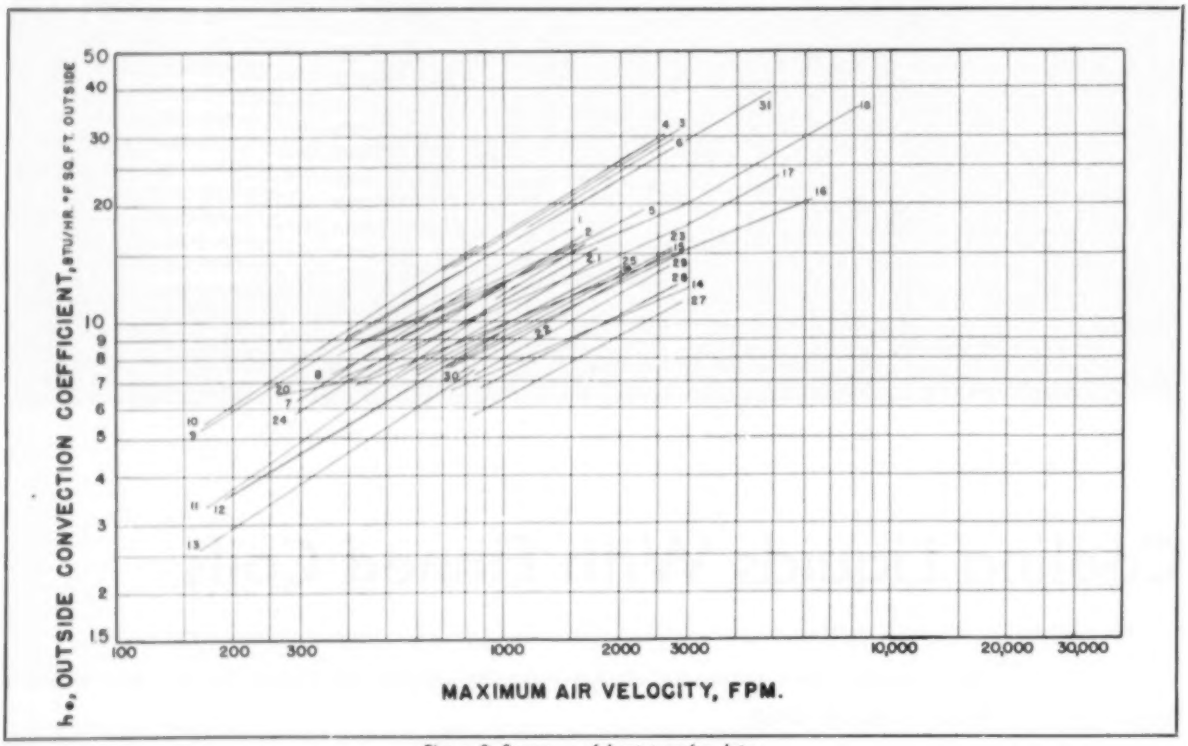

Figure 2. Summary of heat transfer data.

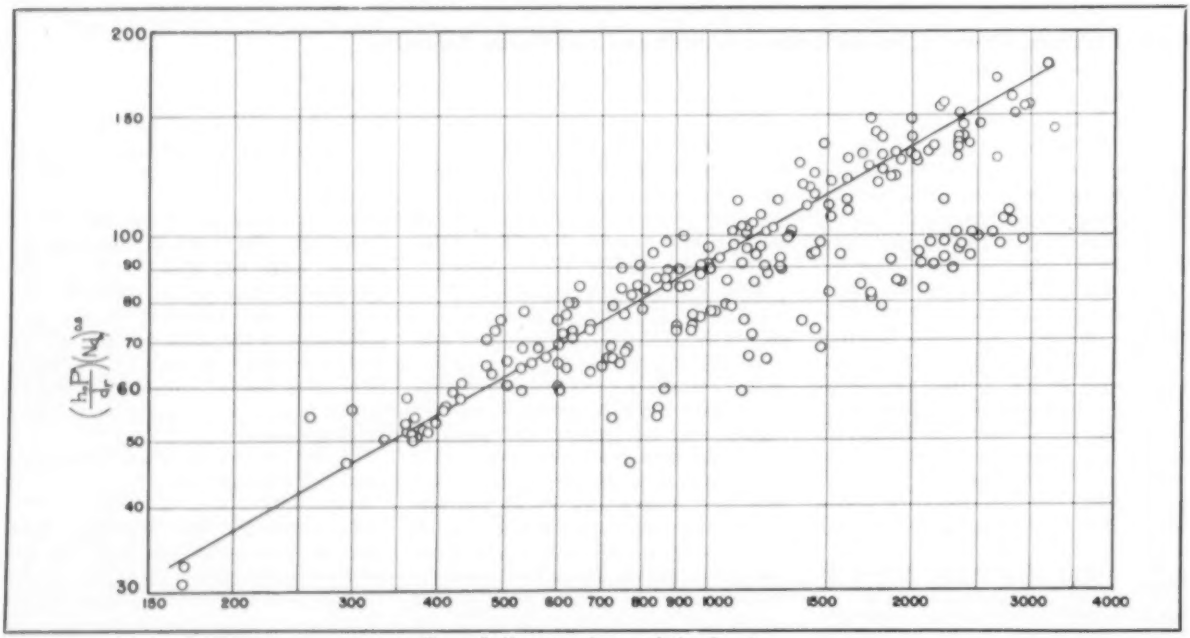

Figure 3. Heat transfer correlation for air.

all triangular spacings with two to eight rows of tubes each. In all cases the average transfer coefficient of all rows was used. No distinction could be made between the heat transfer performances for single rows or multiple rows of tubes.

Figure 3 shows the heat transfer coefficients along with physical dimensions of the system plotted against the maximum air velocity for finned tube coils with triangular spacing of the tubes. It should be noted that the variables included along with the heat transfer coefficients on the outside of the tube are the diameter of the tube at the root, the overall diameter of the fins, the number of fins per inch and the triangular spacing. Reasons cannot be given why some groups of points are considerably below the average of the others since the authors did not have detailed knowledge of all test conditions.

Pressure drop data for air are plotted on Figure 4 where the pressure drop depends upon the equivalent diameter of the tubes, the number of fins per inch, the diameter over the fin and the diameter of the root. The equivalent diameter D_{eb} is defined by Equation 1.

$$D_{eb} = \left(\frac{N\, d_o}{12}\right)\left(\frac{P}{d_r}\right)^2 \qquad (1)$$

In general, there was a better correlation of the pressure drop data than of the heat transfer.

Generalized Correlations—By utilizing those tests in which the tem-

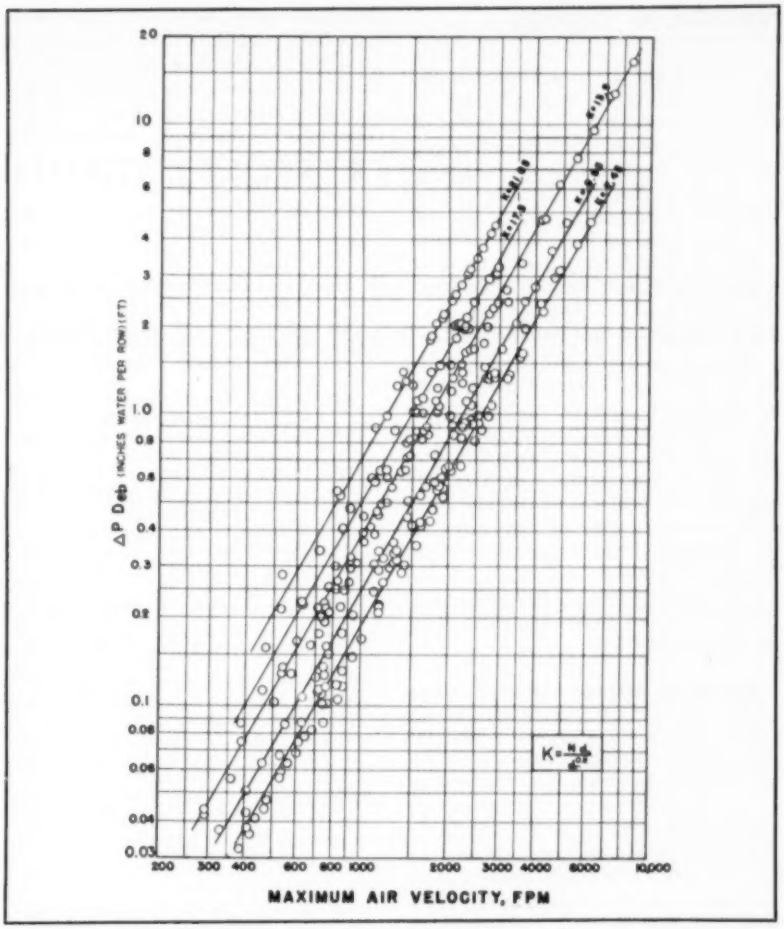

Figure 4. Pressure drop correlation for air.[5]

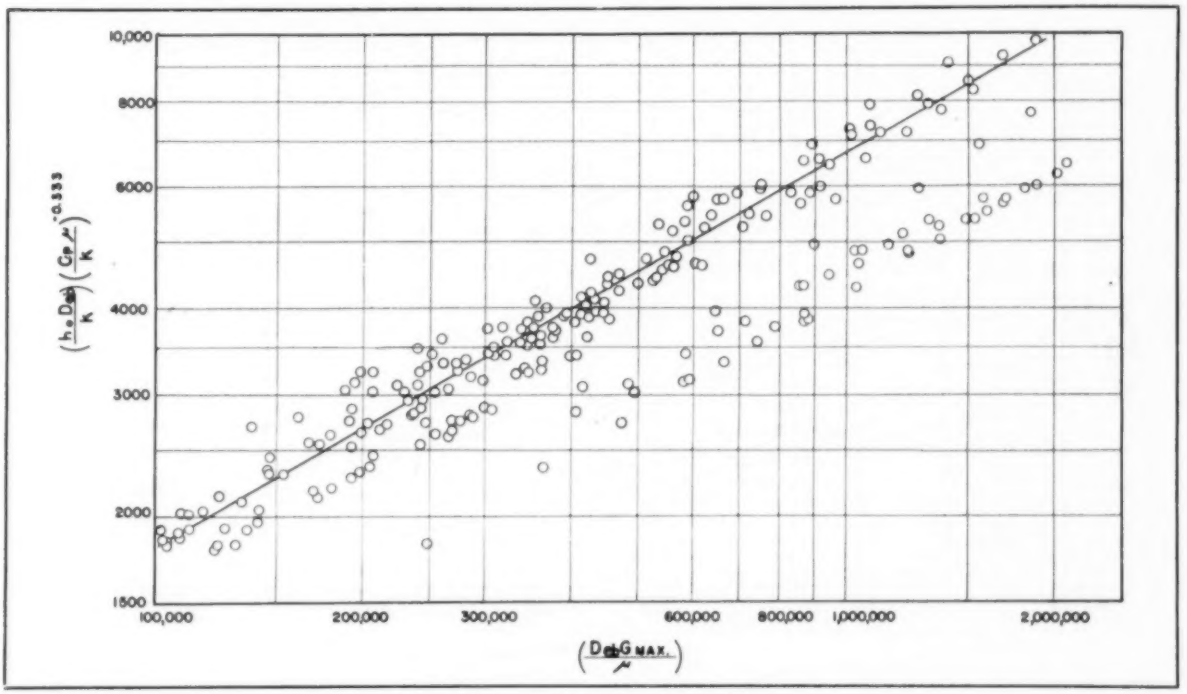

Figure 5. Generalized heat-transfer correlation.

perature of the air was known at the mean condition, it was possible to devise a generalized chart in terms of the Nusselt number, the Prandtl number and the Reynolds number as shown on Figure 5. Not all of the tests provided the temperature of the air and therefore could not be included. Figure 5 may be used for predicting the heat transfer coefficient for any fluid passing across banks of finned tubes when the properties of that fluid are known.

A generalized pressure drop correlation is given in Figure 6 employing the equivalent diameter and the maximum fluid velocity, the number of fins per inch, the diameter over the fins and the diameter at the root. The dotted lines on Figure 6 at the low Reynolds numbers may be indicative of the transition from turbulent to laminar flow conditions.

The correlations of Schmidt[1] were tried but found to be no better than those presented here.

Bond Resistance—Those tubes which are bi-metal were treated in exactly the same manner as integral finned tubes. The resistance due to the bond for bi-metal tubes is believed to be less than 10 percent of the over-all resistance for the usual monometallic tube when used with gases flowing on the outside. If such a resistance is present in the data for bi-metal tubes, it is included in this correlation. Although more bond resistance may have been present in those tubes which gave the lowest heat transfer coefficients on Figure 2, the range in coefficients for monometallic integral finned tubes covered the upper three-quarters of the heat transfer coefficients. On Figure 3, the data which cluster around the correlating line include test data from eight all copper units and nine aluminum-copper bimetallic units.

Effect of Tube Spacing—In assembling finned tube banks, the clearance between the tubes has considerable effect on heat transfer coefficients and pressure drop as noted by the correlations. The best heat transfer is obtained for a given number of tubes when the tubes are arranged with fins tip to tip. A reduction in heat transfer and pressure drop occurs when the space between the tips of the fins is increased. Air passing through this space would come in contact only with every other row. The correlations may be used to find the economics of the situation by computing pressure drop and heat transfer performance for various spacings.

NOMENCLATURE

C_p	Specific heat of fluid at average temperature, Btu/(lb)(°F)
D_{eb}	Equivalent diameter for tube bank, ft.
d_i	Inside tube diameter, inches
d_o	Diameter over the fins, inches
d_r	Finned tube root diameter, inches
G_{max}	Maximum mass velocity in cross flow outside tube banks, lb/(hr)(ft²)
h_o	Outside film coefficient, Btu/(hr)(°F)(ft² outside area)
K	Parameter for cross flow pressure drop
k	Thermal conductivity of fluid at average temperature, (Btu)(ft)/(hr)(°F)(ft²)
N	Number of fins per inch
P	Triangular tube spacing, inches
P_l	Longitudinal pitch, distance between two tubes in a row parallel to flow direction, inches
P_t	Transverse pitch, distance between two tubes in a row normal to flow direction, inches
$\triangle P$	Pressure drop for crossflow of fluids in tube banks, inches water per row of tubes normal to flow direction
V_{max}	Maximum fluid velocity through minimum free-flow face area, ft/min.
Re	Reynolds number
ρ	Density of fluid at average temperature, lb/ft³
μ	Viscosity of fluid at average temperature, lb/(ft)(hr)

ACKNOWLEDGMENT

Permission to publish this paper by Wolverine Tube Division of Calumet and Hecla Incorporated is appreciated. The courtesy of a group of industrial laboratories in permitting their data to be used in the correlation is acknowledged.

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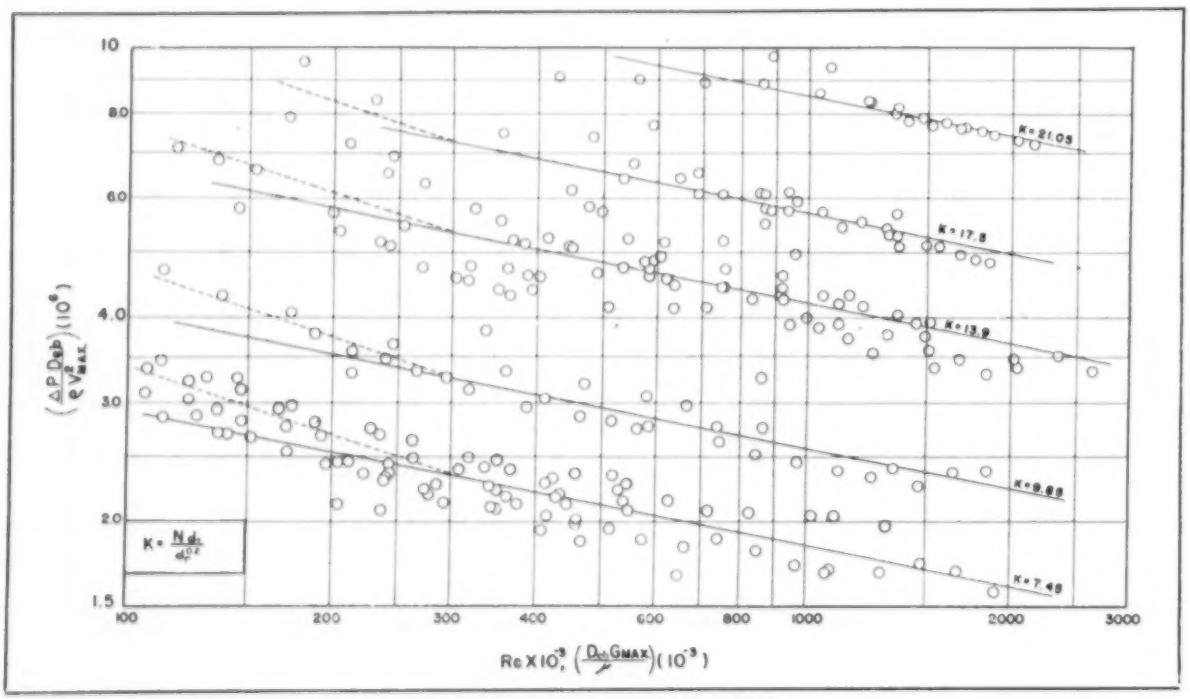

Figure 6. Generalized pressure drop correlation.

Short-cut method for . . .

Locating Optimum Feed Tray

Calculating time can be greatly reduced by short-cut methods for locating the feed tray. This method has good accuracy as can be seen from the comparison with tray-to-tray calculations.

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WITH A NEW distillation project, short cut methods can save much time in selecting the optimum operating conditions. Once these conditions are specified tray to tray calculations can then be used for the final analysis of the problem. Such a procedure reduces to a minimum the number of tray to tray calculations which are time consuming and may require extensive equilibrium data.

There are relatively few easily applied short cut methods for fixing the feed inlet position. In this article a simple rapid method is suggested for determining the number of equilibrium stages above the feed tray. This method, as summarized in Equation (1), has been found to give good results on a large number of binary and multicomponent systems.

Total Number of Equilibrium Stages—Several short cut methods have been proposed for calculating the total number of equilibrium stages in the column.[1, 2, 9, 10, 11] The two most commonly used are those of Brown and Martin,[11] and Gilliland[10] which both rely directly on minimum reflux and minimum plate limits.

In continuous multicomponent distillation, the presence of other components influences the separation of the key components and the evaluation of their minimum reflux ratio R_m. This minimum reflux ratio is best determined using the equations of Underwood[16] or Colburn.[4]

The minimum number of plates in the column is determined by the equation of Fenske:[8]

$$N_m = \frac{\log\left[\left(\frac{X_C}{X_D}\right)_D \left(\frac{X_D}{X_C}\right)_B\right]}{\log \alpha}$$

Feed Tray Location—The tray location ratio, which is the ratio of the number of equilibrium stages above the feed tray to the total number of equilibrium stages in the column, i.e. $\frac{n}{n+m}$, can be determined for a given reflux ratio by the Smoker equation,[15] by plate to plate analysis, or by graphical construction. In this ratio the total number of equilibrium stages, i.e. $(n + m)$ includes the still equilibrium stage. At total reflux this ratio is the same as that for the plate location ratio given by the Fenske equation[8] and is referred to as $\left(\frac{n}{n+m}\right)_T$. It is therefore reasonable to suppose that at high reflux these plate location ratios will be approximately equal.

In order to investigate the difference in the plate location ratios, $\left(\frac{n}{n+m}\right)$, $\left(\frac{n}{n+m}\right)_T$, at low reflux ratios the equilibrium data for benzene-toluene[13] and for benzene-n-heptane[7] has been plotted on large graph paper and the plate location ratio $\left(\frac{n}{n+m}\right)$ determined for varying reflux ratios and different separations. This data is summarized on Table 1.

It will be seen (Table 1) that the plate location ratio $\left(\frac{n}{n+m}\right)$ varies very slightly with the reflux ratio; thus the ratio of the number of equilibrium stages is almost independent of the reflux ratio. The slight deviation which is present, is highest when the feed composition approaches the bottoms composition and R is equal to $1.5\ R_m$.

The following equation is therefore proposed for locating the number of stages above the feed tray

$$n = \left(\frac{n}{n+m}\right)_T (n+m) \qquad (1)$$

For a liquid feed the minimum number of trays between the reflux and feed composition, is determined by means of the Fenske[8] equation, using the ratio of key components in the reflux and feed; it is assumed that the ratio of key components in the entering feed is the same as that in the liquid leaving the tray above the feed tray.

With flash vaporization of the feed the minimum number of trays is calculated between the ratio of key com-

TABLE 1
Benzene-Toluene[13]

Mol. Fraction Benzene				1.5 R_m			3.0 R_m			6.0 R_m			Total Reflux		
X_D	X_F	X_w	R_m	n	n+m	$\frac{n}{n+m}$	n	n+m	$\frac{n}{n+m}$	n	n+m	$\frac{n}{n+m}$	n	n+m	$\frac{n}{n+m}$
0.98	0.70	0.02	0.81	6.6	14.8	0.44	4.55	11.1	0.41	4.0	9.8	0.41	3.6	8.5	0.41
0.98	0.50	0.02	1.19	7.6	15.7	0.48	5.75	11.75	0.49	4.9	9.9	0.49	4.3	8.5	0.49
0.98	0.3	0.02	2.42	7.9	14.3	0.55	6.4	10.7	0.60	5.9	9.4	0.63	5.4	8.5	0.63
0.95	0.50	0.05	1.05	5.6	12.2	0.46	4.0	8.7	0.46	3.7	7.6	0.49	3.2	6.5	0.49
0.90	0.50	0.10	0.83	4.0	9.5	0.42	3.0	6.7	0.45	2.7	5.7	0.47	2.4	4.9	0.49
Benzene-n-Heptane[7]															
0.90	0.50	0.10	2.0	11.1	18.1	0.61	6.7	11.0	0.61	6.2	10.0	0.62	5.3	8.5	0.62
0.90	0.30	0.10	3.0	10.3	14.3	0.72	8.0	10.7	0.75	6.8	9.0	0.76	6.5	8.5	0.76

ponents in the reflux composition and the ratio in the liquid fraction of the feed. Since the ratio of the key components in the liquid fraction of the feed is assumed to be the composition of the liquid leaving the feed tray the number of trays determined by the Fenske equation includes, in this instance, the feed tray.

Feed Tray Location Comparisons—A comparison is given in Table 2 of calculations by plate to plate analysis, by Kirkbride's[12] method, and by Equation (1).

In Table 2, Examples 1 through 4 are for the binary system benzene-toluene with the overhead and bottoms compositions being in each case 95.0 percent benzene and 95.0 percent toluene. The feed composition for Example 2 is 10.0 percent benzene, for Example 3 88.6 percent benzene and for Example 4 20.0 percent benzene. Examples 5 through 11 are for ternary and multicomponent systems.

Kirkbride's[12] relationship is as follows:

$$\log \frac{n}{m} = 0.206 \log \left[\left(\frac{B}{D} \right) \left(\frac{x_D}{x_C} \right)_F \left(\frac{x_{CB}}{x_{CD}} \right)^2 \right] \quad (2)$$

where n = number of equilibrium stages above the feed tray
m = number of equilibrium stages below the feed tray
x_C = fraction of more volatile key component
x_D = fraction of less volatile key component
D = mols distillate
B = mols bottoms
F = mols feed

In the calculations by Equation (1) on Table 2 the total number of stages (n + m) by tray to tray analysis is used. Almost exactly the same results are obtained if the short cut correlation of Gilliland[10] is used to determine the total number of equilibrium stages in the column.

From Table 2 it can be seen that Equation (1) gives results that are in close agreement with those calculated by tray to tray analyses and by Equation (2). It is particularly interesting to note that accurate results are obtained for multicomponent systems. If the tray location ratio $\left(\frac{n}{n+m}\right)$ at the operating reflux ratio given in Table 2 is plotted against the tray location ratio $\left(\frac{n}{n+m}\right)_T$ at total reflux the experimental points lie on the diagonal line up to a tray location ratio of 0.6. The plot of these experimental points is shown on Figure 1. When the tray location ratio is greater than 0.6, and when R is less than 2 R_m, then for the systems investigated the points lie slightly above the diagonal line. This is to be expected from previous considerations since when $\frac{n}{n+m} = 0.6$ the feed composition approaches the bottoms composition.

The dotted line on Figure 1 can therefore be used as a correction factor to Equation (1) when the tray location ratio is greater than 0.6 and $R < 2\,R_m$. When $R > 2\,R_m$ Equation (1) is used.

Example I

Consider the calculation of Example 11, Table 2.

Minimum Stages Above the Feed Tray, (n_m):

Using Fenske Equation—

Reflux composition phenol 95.3%, *o*-cresol 4.55%, *m*-cresol 0.15%.

Feed composition phenol 35.0%, *o*-cresol 15.0%, *m*-cresol 30.0%, xylenols 15.0%, residue 5.0%.

Relative volatility of phenol to *o*-cresol = 1.25.

$$n_m = \frac{\log \left[\left(\frac{95.3}{4.55} \right) \left(\frac{15.0}{35.0} \right) \right]}{\log 1.25} = 9.8 \text{ stages}$$

Minimum Stages in the Column, $(n + m)_m$:

Using Fenske Equation—

Bottoms composition phenol 5.24%, *o*-cresol 20.2%, *m*-cresol 44.7%, xylenols 22.4%, residue 7.5%.

$$(n+m)_m = \frac{\log \left[\left(\frac{95.3}{4.55} \right) \left(\frac{20.2}{5.24} \right) \right]}{\log 1.25} = 19.4,$$

i.e. includes the still equilibrium stage.

Number of Stages in the Column, (n + m):

R_m is calculated using Underwood equation.

At a reflux ratio of 10:1 the Gilliland[10] correlation involving a relationship between $\frac{n - n_m}{n+1}$ and $\frac{R - R_m}{R+1}$ gives a total of 26.7 stages.

Number of Equilibrium Trays Above the Feed Plate:

Since $\frac{n_m}{(n+m)_m} = \frac{n}{(n+m)_T}$ at total reflux,

by Equation (1) $n = \frac{9.8}{19.4} \times 26.7 = 13.5$

By tray to tray analysis the number of stages above the feed tray is 13.0.

Example II

Consider the case of Example 9, Table 2.

Minimum Stages Above the Feed Tray:

Reflux composition, $C_1 = 5.6\%$, $C_2 = 10.1\%$, $C_3 = 81.0\%$, $C_4 = 3.3\%$.

Feed composition, $C_1 = 2.94\%$, $C_2 = 2.94\%$, $C_3 = 20.6\%$, $C_4 = 23.5\%$, $C_5 = 20.6\%$, $C_6 = 29.4\%$ (Liquid fraction).

Relative volatility $C_3/C_4 = 2.24$

$n_{m\,in}$ above feed tray =

$$n_m = \frac{\log \left[\left(\frac{81.0}{3.3} \right) \left(\frac{23.5}{20.6} \right) \right]}{\log 2.24} - 1.0$$

$$= 4.2 - 1.0 = 3.2$$

TABLE 2

	Total Number of Stages (n+m)						Stages Above Feed Tray			
	Plate to Plate Analysis	Gilliland	R_m	R	$(n+m)_{min}$	n_{min} Above Feed Tray	Plate to Plate Analysis	Equation (1)	Equation (2)	System Reference
1	8.8	8.6	1.0	3.0	6.5	3.2	4.2	4.3	4.4	Robinson and Gilliland [14]
2	8.6	9.1	5.7	10.2	6.4	5.8	7.2	7.8	6.4	Benzene-Toluene
3	7.8	9.2	0.05	0.6	6.4	1.0	1.0	1.2	1.9	Benzene-Toluene
4	8.5	9.1	3.4	6.3	6.4	5.0	5.9	6.5	5.5	Benzene-Toluene
5	16.0	16.5	1.0	2.0	11.0	5.0	7.0	7.3	7.1	Robinson and Gilliland [14]
6	21.5	21.0	2.2	5.0	15.5	7.7	10.5	10.7	12.0	Coulson, Warner [5]
7	8.8	9.0	2.0	9.0	7.8	5.6	6.0	6.3	5.7	Brown, Souders [3]
8	17.0	17.8	1.35	3.0	12.8	4.5	6.0	6.0	5.9	Brown, Souders [3]
9	16.0	16.0	0.95	1.5	8.7	3.2	6.0	5.9	5.9	Edmister [6]
10	11.0	10.9	0.9	2.0	7.7	2.3	3.0	3.3	3.2	Robinson and Gilliland [14]
11	26.0	26.7	5.1	10.0	19.4	9.8	13.0	13.5	13.5	Robinson and Gilliland [14]

NOMENCLATURE

n	number of equilibrium stages above the feed tray.
n_m	minimum number of equilibrium stages above the feed tray.
m	number of equilibrium stages from the feed tray to the still composition.
m_m	minimum number of equilibrium stages from the feed tray to the still composition.
$\left(\frac{n}{n+m}\right)$	plate location ratio at operating reflux.
$\left(\frac{n}{n+m}\right)_T$	plate location ratio at total reflux.
x_C	fraction of more volatile key component.
x_D	fraction of less volatile key component.
D	mols of distillate.
B	mols of bottoms.
F	mols of feed.
R	reflux ratio.
R_m	minimum reflux ratio.
α	relative volatility of the more volatile key component to the less volatile component.

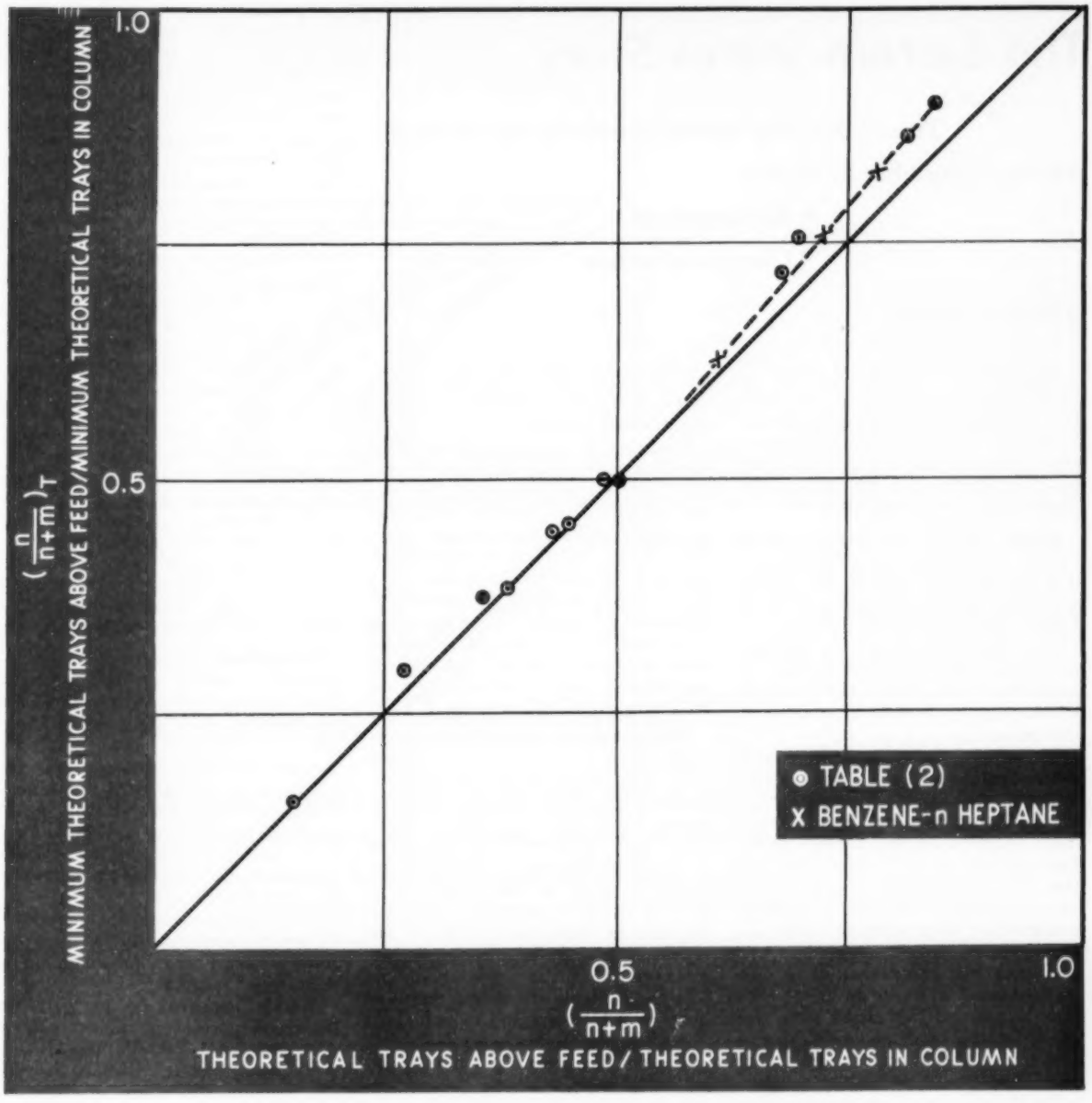

Figure 1. Relationship of tray location ratios at total and varying reflux.

Minimum Stages in the Column:

Bottoms composition, $C_3 = 1.0\%$, $C_4 = 41.6\%$, $C_5 = 27.4\%$, $C_6 = 30.0\%$.

Relative volatility $C_3/C_4 = 2.24$

$$(n+m)_m = \frac{\log\left[\left(\frac{81.0}{3.3}\right)\left(\frac{41.6}{1.0}\right)\right]}{\log 2.24} = 8.7,$$

i.e. includes the still equilibrium stage.

Number of Stages in the Column:

At a reflux ratio of 1.5:1.0 the Gilliland[10] correlation gives a total of 16.0 stages.

Number of Equilibrium Stages Above the Feed Tray:

By Equation (1)

$$n = \frac{3.2}{8.7} \times 16.0 = 5.9$$

By tray to tray analysis the number of equilibrium stages above the feed tray is 6.0.

Since the completion of this article it has been noted that Maxwell, page 234, "Data Book for Hydrocarbons," D. van Nostrand Company, Inc., New York, 1951, makes suggestion for using a method similar to this one involving Equation (1). However, Maxwell uses a slightly different flash vaporization procedure and does not include his supporting data.

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The Eastern States Story

This Gulf Coast refiner insures success by maintaining top quality in • Men • Management • Communications

William G. Dudley,
REFINER Staff

REFINING A WIDE RANGE of crudes, making a variety of end products to rigid customer specifications, constantly shifting production schedules—all these and a profit, too—not an easy job. Yet one company on the Gulf Coast is doing just this.

How?—That is the Eastern States Petroleum Company story. The secret, if it can be called this, of this success story lies in the philosophy of R. B. Kahle, president of the company.

In a broad sense this is the philosophy; give a man enough authority to match his responsibility. Let a man do his work as an individual member of the team.

This team-individualism would seem almost contradictory at first glance. The fact that it is not contradictory depends on three things: management, men, communications. Eastern States has top quality in all three. The fact that the system is effective shows up in every phase of the operation—from construction to production—from research to sales.

Eastern States does most of its own construction. It holds to the theory that because of the varied nature of the jobs, the relatively small size of many of the changes, Eastern States can do its construction more economically than it can be contracted. This theory, which would certainly not apply in all cases, has definitely been proved right for this company. An example of speed: Eastern States built a 7500-barrel-per-day Platforming unit from groundbreaking to on-stream operation in six months.

How?—The chief engineer, H. M. Martin, gives most of the credit to management and to his staff. Once the management gives the go ahead on a project, the engineering department has an extremely free hand.

In the case of blueprints and drawings, only those necessary for construction are made. If a drawing is not deemed essential, the job engineer is given the responsibility of doing the work as best he can. This not only cuts red tape, but also gives the man a chance to use his experience, ingenuity, and native abilities.

Construction and material coordination is carried out by the project engineer. He acts as go-between for the job and all offices. Eastern States has no "bluebook" of construction practices. Again, note the individualized approach. Management, located near by, is always available for immediate decisions. Obviously, this cuts out a great deal of lost time. By being located near the plant top management can keep its very personal finger on the entire company's operations.

Maintenance—In maintenance, the Engineering department, whose charge it is, acts almost as an outside contractor. Whenever possible, maintenance is carried on without paper work. This is done by close agreement in the field—another evidence of the fine team work in this company. If the job involves something that the engineering department feels is not necessary or if the engineering department questions the necessity of the job, the department wanting the work done must fill out a job request. This allows for discussion between the Engineering department and the department requesting the work. Should they not agree, the department requesting the work must get approval through management. A case such as this is the exception rather than the rule.

One other item of interest is the small inventory of mechanical items carried by the company. Eastern States prefers to deal with local suppliers in cases where prices are in line. Because of the location of several refineries of considerable size in what might be termed the vicinity of the Eastern States plant, local suppliers maintain stocks which are in almost all cases capable of supplying the demands of Eastern States.

Research—A small group, directly responsible to management, takes care of all of Eastern States' research. This research involves the development of new products and new processes and the improvements of old ones. The group carries research up to the process point at which time it gives the necessary flow sheets and other pertinent information to the engineering groups for estimates and evaluation. This information is then transmitted directly to management which is, as always, immediately available.

Training—This "maximum effort" for flexibility and efficiency is again pointed out in the training of the employes at Eastern States. Each stillman and some of the assistant stillmen spend about one month out of the year working in units other than the one in which they spend the other 11 months. This is done to increase the value of the individual man, to again provide more flexibility among the operating personnel, and to familiarize the men with the problems in all of the units.

The advantages of such a training program are obvious. One of the advantages that might go unnoticed is that should one unit in the process train get into trouble, stillmen in other units will know what to expect.

Operations—Eastern States manufactures a variety of end products. The company is peculiarly adapted for this type of work. Although a large part of its business is under long term contract, supplying spot markets represents a considerable portion. Supplying customer demands both as to product specifications and time of delivery have given the company the experience and know-how to carry on this type of operation.

These quick changes in operations, as well as rapid construction have enabled Eastern States to obtain many short term contracts.

Weekly requirements are given to the crude purchasing division. These teletyped reports provide the close coordination necessary in carrying out this type of operation. Incidentally, this coordination is a seven day per week job.

The refinery produces a variety of specialty products such as alkylates and aromatics. This variety is somewhat uausual in refineries of this size and allows much flexibility in product blending. Rather than use large storage facilities, the company depends on rapid blending and testing, extremely close liaison between sales, refining, and crude purchasing, and engineered refinery flexibility. An example of the latter is the very complete manifolding between the six heaters that feed the two topping units. This manifolding allows any crude to be run to any or all of the heaters and allows any or all of the heaters to feed either or both of the topping units.

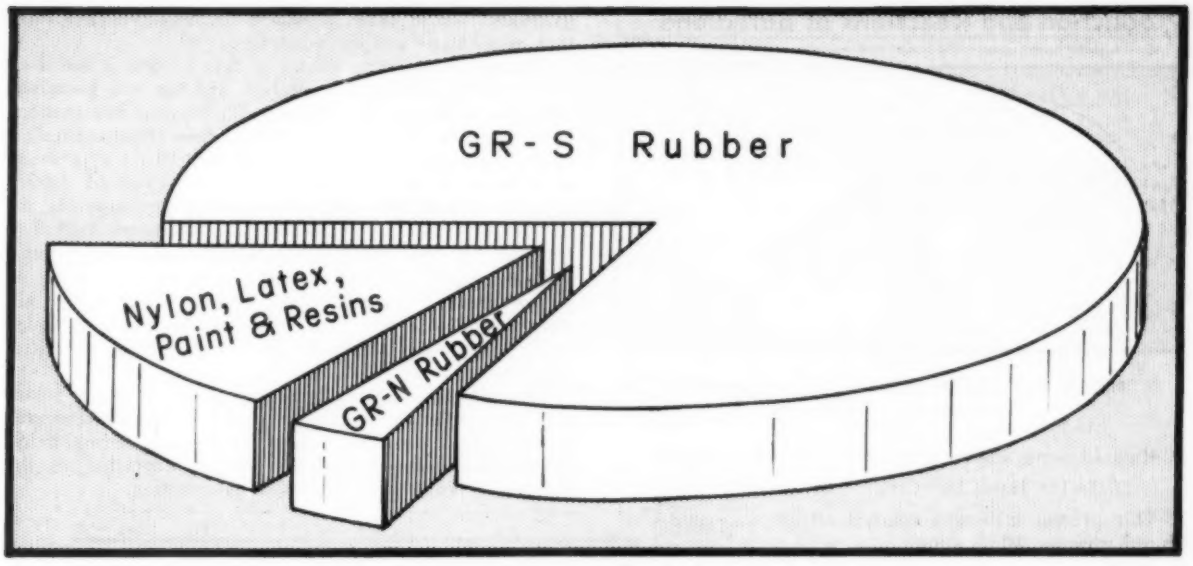


Figure 1. Predicted use pattern for butadiene in 1955.

Understanding the chemistry of . . .

Petrochemical Reactions

Part 15. The Oxo Reaction–Primary Alcohols from Olefins

Part 16. The Production and Reactions of Butadienes

Part 17. Preparation and Properties of Acetylenes

Lewis F. Hatch,
The University of Texas,
Austin

ONE APPROACHES a discussion of butadiene ($CH_2 = CHCH = CH_2$) with some trepidation for probably no single organic compound in recent years has received so much publicity. Butadiene has many facets which make it of interest. It is produced in large quantities from petroleum and is on occasion also produced from ethyl alcohol. Butadiene is used to make synthetic rubber (Figure 1) which is both essential to our way of life and intimately associated with natural rubber and all of its international trials and tribulations. The tax payer is concerned with butadiene because about 88 percent of the current capacity is government owned (Figure 2). The government, however, is at present undergoing the throes of turning these plants over to private industry. This conversion should be completed some time after the middle of 1955.

Butadiene is also a reactive compound with many potential uses as a raw material for chemical synthesis. It is this aspect of butadiene in which we will be most interested.

Methods of Preparation—With butadiene being essential to modern war, it is not surprising that each country has developed its own method of preparation depending upon its available raw materials. During World War II (1944) the United States produced about 60 percent of its butadiene from ethyl alcohol and the rest based on petroleum. In 1945 the relative positions were reversed with 60 percent of the butadiene coming from petroleum. The alcohol process is now used only in times of abnormal stress.

Germany used two routes to butadiene, both based on acetylene. The main process was from acetaldehyde by way of aldol ($CH_3CHOHCH_2CHO$) and 1,3-butandiol ($CH_3CHOHCH_2CH_2OH$) while the other method used 1,4-butyndiol ($CH_2OHC{\equiv}CCH_2OH$) as an intermediate.

$$HC{\equiv}CH + H_2O \rightarrow CH_3\overset{\overset{O}{\|}}{C}{-}H$$

$$2CH_3\overset{\overset{O}{\|}}{C}{-}H \rightarrow CH_3CHOHCH_2\overset{\overset{O}{\|}}{C}{-}H$$

$$CH_3CHOHCH_2\overset{\overset{O}{\|}}{C}{-}H + H_2 \rightarrow CH_3CHOHCH_2CH_2OH$$

$$CH_3CHOHCH_2CH_2OH \rightarrow CH_2{=}CHCH{=}CH_2 + 2H_2O$$

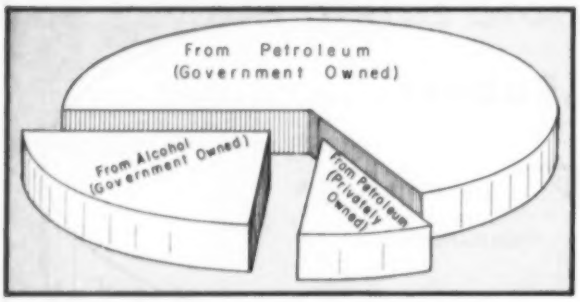


Figure 2. Distribution of U. S. butadiene capacity—1953. Total capacity = 852,000 tons.

Russia used a one stage process from ethyl alcohol.

$$2CH_3CH_2OH \rightarrow CH_2{=}CHCH{=}CH_2 + 2H_2O + H_2$$

This process utilizes a catalyst at 400 C., and a reduced pressure (0.25 atms.).

Other methods have been proposed for use in the United States and some have been developed to the pilot plant stage. These include the dehydrohalogenation of the dichlorobutanes

$$CH_3CHClCHClCH_3 \rightarrow CH_2{=}CHCH{=}CH_2 + 2HCl$$

and the dehydration of 2,3-butylene glycol (CH_3-$CHOHCH_2OHCH_3$). The dichlorobutanes may be dehydrochlorinated by passing their vapors through a molten salt bath containing aluminum chloride and potassium chloride or through a pyrex tube (450 C.) or chrome-molybdenum cast-steel tube (700 C.). The glycol is first changed to the corresponding diacetate, then pyrolyzed.

$$CH_3CHOHCHOHCH_3 + 2CH_3COOH \rightarrow CH_3\overset{\displaystyle O}{\overset{\|}{C}}OCH_2CH_2CH_2CH_2OC\overset{\displaystyle O}{\overset{\|}{C}}CH_3 + 2H_2O$$

$$CH_3\overset{\displaystyle O}{\overset{\|}{C}}OCH_2CH_2CH_2CH_2OC\overset{\displaystyle O}{\overset{\|}{C}}CH_3 \rightarrow CH_2{=}CHCH{=}CH_2 + 2CH_3COOH$$

In the first method 1,2- and 2,3-dichlorobutane are readily formed by the addition of chlorine to the 1- and 2-butenes. The butylene glycol is derived from starch which has been acid hydrolyzed, then fermented with *Aerobacter aerogenes*. A bushel of grain will give about 7 pounds of butadiene.

All of these methods for the production of butadiene are not competitive with butadiene from petroleum except in periods of emergency.

Butadiene from Petroleum—Butadiene may be produced from petroleum by either dehydrogenation of butane and butenes or the cracking of higher molecular weight hydrocarbons.

The high temperature (above 650 C.) *cracking of liquid hydrocarbons* will yield butadiene but in only small amounts. The contact time should be less than one second to minimize the decomposition of the butadiene and also to inhibit the formation of aromatics. Ordinary or reduced pressure should be used, because the cracking process involves an increase in the number of molecules. The ease of formation of butadiene from various types of hydrocarbons is in the following order: aromatics < paraffins < olefins < naphthenes < unsaturated naphthenes.

The main route from petroleum is by the *catalytic dehydrogenation* of either *n-butane*, the *n-butenes* or a mixture of *n*-butane and the *n*-butenes.

One of the major problems in this process is the deposition of carbon on the catalyst, and the two principal processes differ in the manner of removing this carbon.

One process (Figure 3) uses a chrome- alumina catalyst with an average temperature of about 610 C., a pressure of 5 inches of mercury absolute, a space rate of 2.2-2.7 volumes of feed per volume of catalyst per hour and an on stream time of 8-10 minutes. The on-stream period is followed by a vacuum purge to remove hydrocarbons, and then a regeneration period carried out by circulation of air preheated by direct combustion of fuel in the air stream. The coke deposit on the catalyst is burned under these conditions, and the catalyst is restored to its initial activity.

The other process for butadiene production uses steam as a diluent for the reaction. The use of steam has several advantages. It provides preheat for the endothermal dehydrogenation reaction, and the carbon deposited on the catalyst is removed by the water gas reaction.

$$C + H_2O \rightarrow CO + H_2$$

A calcium-nickel phosphate catalyst promoted with chromium sesquioxide is used in several plants. However, the bulk of the butadiene produced in this country is produced by dehydrogenation of n-butenes over iron oxide catalyst.

The yields by these processes are around 60-65 percent on a 20-30 percent conversion. The high temperature cracking of liquid hydrocarbons normally gives yields of butadiene between 2 and 5 percent. Especially selected feed stocks, high in naphthenes, may give yields as high as 15 to 20 percent.

Separation of Butadiene—The separation of butadiene from the other co-present C_4 hydrocarbons presents a problem because only a partial separation can be achieved by fractional distillation. The various compounds boil close together and form mixtures with abnormal vapor pressures. Butadiene can be separated, however, in a purity of 99 percent by both physical and chemical means. These methods are: (1) Solvent extraction, (2) Azeotropic and extractive distillation, (3) Absorption in solvents to form chemical complexes and (4) Formation of chemical compounds which are separated and decomposed to regenerate the pure diene.

Solvent extraction has not received a great deal of attention, for other methods of butadiene purification appear to have more general utility. The following solvents have been proposed: glycol esters and ethers, furfural, triethanolamine and methyl alcohol.

Azeotropic and extractive distillation processes are based upon the addition of a third component which alters the relative volatility relationship of the monoolefins and butadiene of the same or nearly the same boiling points. Ammonia has been widely used in azeotropic distillation and appears to be especially useful with feed-stocks containing more than 45 percent butadiene. Ammonia has the disadvantage of being an inhibitor for the subsequent polymerization of the butadiene.

Furfural has been used on a very large scale in the extractive distillation of butadiene. In the presence of furfural butadiene has a vapor pressure lower than any of the other C_4 hydrocarbons. Normally the relative volatility of butadiene is lower than that of isobutane, isobutylene and 1-butene and higher than that of *n*-butane, *trans*-2-butene and *cis*-2-butene.

Complex formation with cuprous salts is also used for the separation of butadiene. The crude butadiene is passed

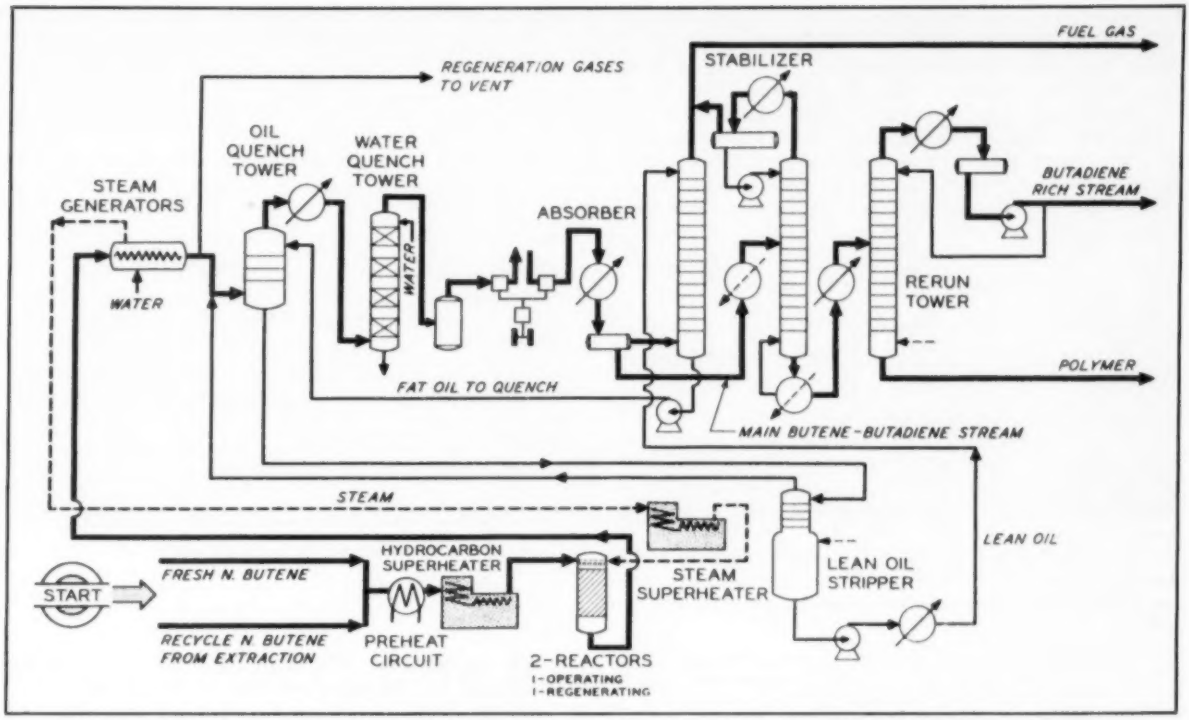
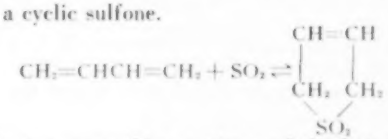


Figure 3. Production of butadiene by the dehydrogenation of C_4 hydrocarbons. (Courtesy Standard Oil Development Company.)

into the bottom of a packed absorption tower containing a solution of ammoniacal cuprous acetate at a relatively low temperature. The butadiene dissolves in the solution which then passes into a desorption tower for separation of the butadiene from the solution at a higher temperature. Under these conditions butadiene is approximately ten times more soluble than 1-butene in an ammoniacal cuprous acetate solution.

Compound formation has been almost entirely confined to the reaction between butadiene and sulfur dioxide to form a cyclic sulfone.



This is a reversible reaction and the butadiene can be recovered quantitatively by heating the sulfone to 125 C. This method is useful for the production of pure butadiene.

Reaction of Butadiene—The assured future of buta-

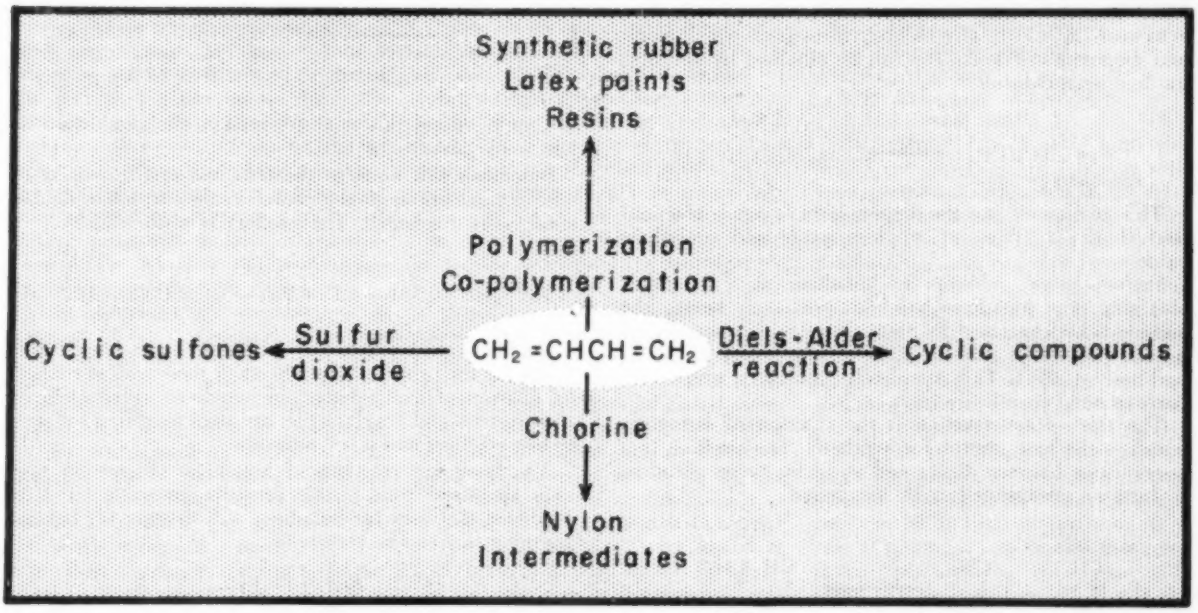


Figure 4. Reactions of butadiene currently being utilized.

diene lies with synthetic rubber; the potential of butadiene is in its chemical versatility. Its low cost, ready availability and great reactivity tempt researchists.

Butadiene will undergo the usual addition reactions of an olefin more readily than olefins with a single double bond. When only one mole of the adding substance is used, there may be either of two products formed or a mixture of the two.

$$CH_2{=}CHCH{=}CH_2 + AB \longrightarrow \begin{cases} \rightarrow CH_2{=}CHCHACH_2B \\ \quad 1,2\text{-Addition} \\ \rightarrow CH_2ACH{=}CHCH_2B \\ \quad 1,4\text{-Addition} \end{cases}$$

Halogens and hydrogen halides give both 1,2- and 1,4-addition products. The ratio of products is governed to some extent by the temperature of the reaction. For example, hydrogen bromide adds 1,2 to give 3-bromo-1-butene ($CH_3CHBrCH = CH_2$) below 0 C., but above that temperature crotyl bromide ($CH_3CH = CHCH_2Br$) is the main product. The 1, 2- and 1, 4-addition products of the hydrogen halides will undergo allylic rearrangement into an equilibrium mixture in the presence of hydrogen ion (H^+).

$$\underset{\text{3-Chloro-1-butene}}{CH_2CHClCH{=}CH_2} \rightleftharpoons \underset{\textit{trans}\text{-Crotyl chloride}}{CH_2CH{=}CHCH_2Cl}$$

The addition of *chlorine* to butadiene

$$CH_2{=}CHCH{=}CH_2 + Cl_2 \rightarrow \underset{\text{1,4-Dichloro-2-butene}}{CH_2ClCH{=}CHCH_2Cl}$$

gives a good yield of 1,4-dichloro-2-butene (E. I. du Pont de Nemours & Company). Because of the reactive allylic chlorine atoms this compound will react to give the corresponding dinitrile.

$$CH_2ClCH{=}CHCH_2Cl + 2NaCN \rightarrow \underset{\text{Adiponitrile}}{NCCH_2CH{=}CHCH_2CN} + 2NaCl$$

This nitrile is an intermediate in the production of nylon.

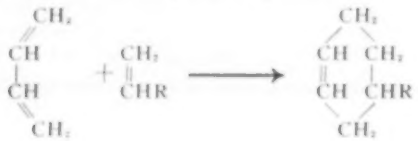
Butadiene also adds one or two molecules of *hypochlorous acid* (HOCl) to give chlorohydrins from which mono and diepoxides of butadiene can be obtained by splitting out hydrogen chloride.

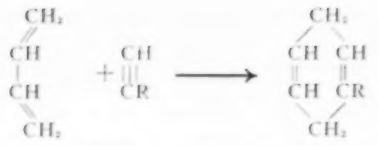
Butadiene monoxide

This compound and the diepoxide have many potential uses similar to those of ethylene oxide and propylene oxide.

Sulfur dioxide addition to butadiene as a means of obtaining pure butadiene has been previously noted. The sulfone is hydrogenated by Shell Chemical Corporation to a saturated cyclic sulfone. This sulfone melts at 28 C., and boils at 285 C. It is completely miscible in water, noncorrosive and chemically inert.

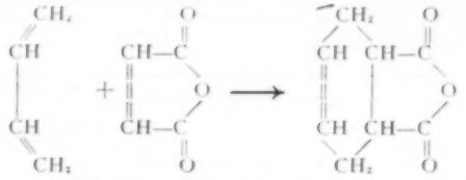
The *Diels-Alder* reaction is the reaction of butadiene which is the most useful for synthesis. The reaction is a general one between dienes and an olefin or an acetylene to form an unsaturated cyclic compound.





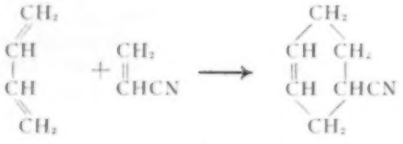
That which adds to the diene is called the *dienophile*, and the R is usually a carbonyl group $\left(\begin{matrix} O \\ \| \\ -C- \end{matrix}\right)$ as in acids, anhydrides, esters, acid chlorides, ketones, aldehydes, quinone, etc., but may also be such groups as nitro, sulfonyl, cyano, vinyl or hydrogen. The product is called the *adduct*.

The best known example of the Diels-Alder reaction in the petroleum industry is that between butadiene and maleic anhydride.



This reaction was used in the early days of butadiene production as a means of analysis for butadiene.

Pimelic acid ($HOOCCH_2CH_2CH_2CH_2CH_2COOH$) has been made from butadiene and *acrylonitrile* with tetrahydrobenzonitrile as an intermediate.



Tetrahydrobenzonitrile

Sodium pimelate

Compounds of this type are used in the production of polyamide plastics (nylons).

Butadiene will undergo the *Oxo reaction* in respect to one carbon-carbon double bond while the other double bond is hydrogenated. The product is *n*-valeraldehyde.

$$CH_2{=}CHCH{=}CH_2 + CO + 2H_2 \rightarrow \underset{\textit{n}\text{-Valeraldehyde}}{CH_3CH_2CH_2CH_2C(=O)H}$$

Butadiene will *polymerize* with styrene in latex forms which are the principal ingredients of the so-called rubber-based paints. Other polymers of butadiene, either alone or with styrene and acrylonitrile, are used as resins for protective coatings and other purposes.

The foregoing reactions of butadiene (Figure 4) give only an introduction to this versatile raw material. It is predicted that uses for butadiene will develop far beyond anything that can be seen today.

End of Part 16.
The concluding part, No. 17, will appear in an early issue.

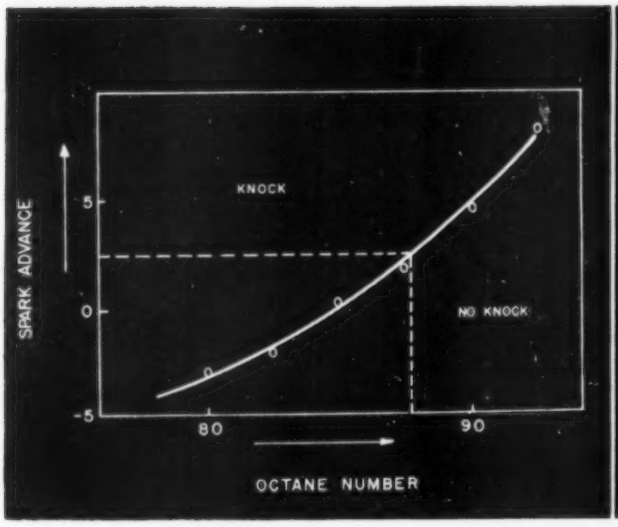


Figure 8—Modified Uniontown

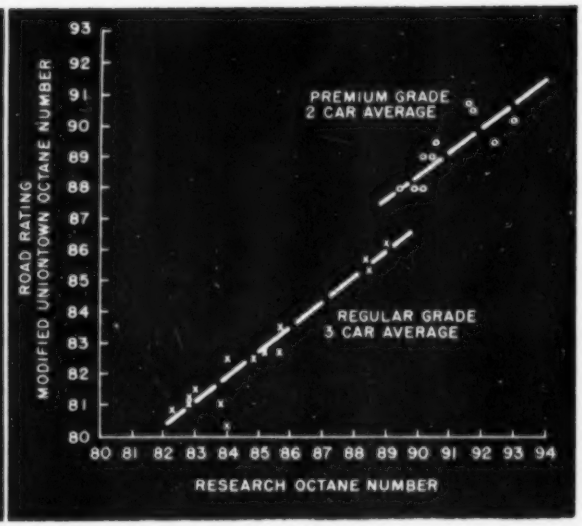


Figure 9 — Relation between research octane number and modified Uniontown rating (commercial gasoline)

What Is the Octane Picture?

Part I. Trends and Forecasts

◗ Part II. Road Rating Effects

J. S. Bellah and W. E. Morris,

E. I. du Pont de Nemours & Company, Wilmington, Del.

THE FIRST article in this series, published in the August issue of PETROLEUM REFINER, reviewed the patterns established in the constantly changing octane picture, and predicted the outlook for the future. This, the concluding article in the series, demonstrates general correlations of the effect on road ratings of certain refinery controllable gasoline quality factors, and outlines laboratory and road testing programs to develop specific correlations whereby optimum usage of octane numbers can be realized.

The actual knock resistance of a gasoline in an automobile engine is not defined accurately by Research octane number. Commercial gasolines of equal Research number may differ appreciably when they are compared on the road. Based on available data, it appears that if 100 commercial gasolines of equal Research rating were chosen at random, and compared on the road, about 20 would differ by more than one octane number from the average road rating. Some of these would be high and some low. This is based on road octane number data obtained by the Modified Uniontown method.

Since all comparisons in this discussion are made with this rating, it might be well to describe the method by going through the mechanics of obtaining a rating. Referring to Figure 8, the spark timing is set at top dead center and a wide-open throttle acceleration is made on 80-octane reference fuel. The knock intensity is too loud. The spark is reset to 3° after top dead center, the acceleration is then repeated with the same fuel, and a maximum of trace knock is obtained at some speed. Then 3° after top dead center is the reference point for 80-octane reference fuel. With 82½-octane reference fuel, the spark is advanced somewhat to obtain trace knock. By testing higher and higher octane reference fuels, the curve of spark setting for trace knock against octane number is obtained. Then suppose a test gasoline is found to give just trace knock at 2½° before top dead center. Comparison with the reference curve indicates an octane number of 88. The Modified Uniontown method gives a single octane number which indicates customer acceptance of gasoline. Octane ratings are based on the spark setting at which knock occurs regardless of the speed at which it occurs.

Correlation of Road Ratings and Laboratory Data—Research octane number is believed to be the most important single factor affecting road octane performance of a gasoline. This is illustrated by Figure 9 which shows the relationship between Research and road ratings for 14 regular grade and ten premium grade gasolines. While the road ratings increase with Research octane number, the inconsistencies are of such a magnitude that other factors must also have an effect. These factors include:

1. Motor octane number
2. TEL content
3. Hydrocarbon composition
4. The test car used

An attempt to correlate both Research and Motor octane numbers with road performance resulted in the relationship shown in Figure 10. Here road depreciation, Research minus road octane, is shown as a function of sensitivity; that is, Research minus Motor octane number. It is seen that road depreciation tended to increase with an increase in sensitivity, but the magnitude of the inconsistencies is no less than when road ratings were compared to Research octane numbers only.

In some cars Motor octane number is as important as Research octane number. In other cars Motor O.N. appears to be of little importance. As a rule of thumb, it is estimated that road octane performance correlates with about 0.7 Research + 0.3 Motor octane numbers.

Tetraethyl lead content has been

The Octane Picture . . .

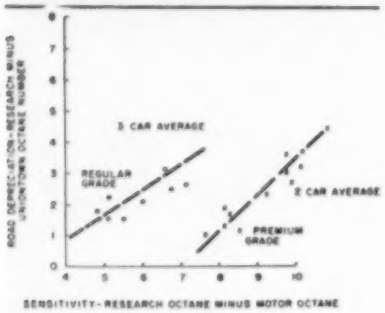


Figure 10—Relation between road depreciation and sensitivity (commercial gasoline).

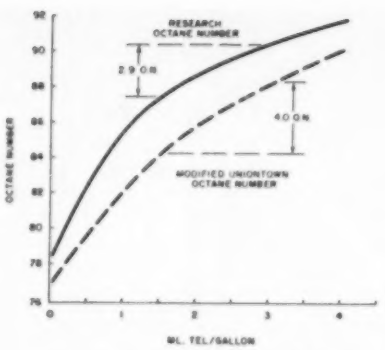


Figure 11—Road and laboratory TEL susceptibility of regular B (3-car average).

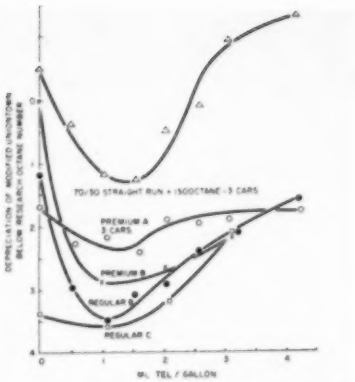

DEPRECIATION OF MODIFIED UNIONTOWN BELOW RESEARCH OCTANE NUMBER
70/30 STRAIGHT RUN + ISOOCTANE - 3 CARS
PREMIUM A 3 CARS
PREMIUM B
REGULAR B
REGULAR C
ML. TEL / GALLON

Figure 12—Road depreciation (average data for all test fuels).

found to have an appreciable effect on road octane rating. In one test program, it was found that increasing TEL content from 0 to 1 cc per gallon gave a road octane number increase smaller than was obtained in the laboratory. On the other hand, increasing TEL content from 1 to 3 cc per gallon, gave road octane number increases greater than were obtained in the laboratory. In order to define these effects more closely, a special program was carried out using commercial gasoline blends with various concentrations of TEL added. TEL response curves determined in the laboratory and on the road for one of these gasolines are shown in Figure 11. It is noted that an increase in TEL content from 1.5 to 3 cc, increased the Research octane and Modified Uniontown road ratings, 2.9 and 4.0 octane numbers respectively. The depreciation of Road below Research rating was greatest at about 1½ cc TEL. This is further illustrated in Figure 12. Here is plotted road depreciation (Modified Uniontown minus Research octane number) against TEL dosage for four commercial gasolines and one special laboratory blend. In each case the road depreciation was lessened when lead dosage was increased from 1.5 to 3.0 cc. For the four commercial gasolines, road gains varied from one-half to one and one-half octane numbers above the Research octane increase.

Even when two gasolines are identical in Research octane number, Motor

TABLE 1

TEL Response Data on Blends of Components B and A

(Case I—With Thermal)

Percent of Component B	Percent of Component A	Research Octane Number ML TEL/Gallon			
		0	1	2	3
0	100	55.0	66.0	72.5	76.0
25	75	66.0	75.4	81.0	82.8
50	50	75.9	83.6	86.9	88.9
75	25	83.8	90.5	92.6	93.9
100	0	90.5	95.3	96.9	97.5

TABLE 2

Daily TEL Requirement

(Case I—With Thermal)

GRADE	B/CD	Percent B In Blend	Desired Research Octane No.	TEL Ml./Gallon	Daily TEL Required Lbs.	Total TEL, Lbs. Premium and Regular
Premium	1554	83	90.0	0.45	167	
Regular	6471	28	83.5	3.00	2966	3073
Premium	1554	80	90.0	0.59	140	
Regular	6471	28.7	83.5	2.95	2916	3056
Premium	1554	75	90.0	0.85	202	
Regular	6471	29.9	83.5	2.83	2798	3000
Premium	1554	70	90.0	1.30	309	
Regular	6471	31.1	83.5	2.62	2590	2899
Premium	1554	65	90.0	1.82	423	
Regular	6471	32.3	83.5	2.50	2472	2904
Premium	1554	60	90.0	2.45	582	
Regular	6471	33.5	83.5	2.40	2373	2955
Premium	1554	56	90.0	3.00	712	
Regular	6471	34.5	83.5	2.30	2274	2986

TABLE 3

Compositions of Eight Blending Components Used Under Four Different Blending Cases Each of Which Represented a Different Magnitude of Thermal Reforming

	CASE I				CASE II				CASE III				CASE IV			
Amount Thermal Reforming	None				50 Percent				70 Percent				100 Percent			
Gasoline Production Bbl./D	13,831				13,518				13,393				13,205			
	A		B		C		D		E		F		G		H	
Component	Bbl./D	Vol. Percent	Bbl./D	Vol. Percent	Bbl./D	Vol. Percent	Bbl./D	Vol. Percent	Bbl./D	Vol. Percent	Bbl./D	Vol. Percent	Bbl./D	Vol. Percent	Bbl./D	Vol. Percent
COMPOSITION BASED ON 9.0-POUND REID VAPOR PRESSURE STOCKS																
LT SR	5632	74.8			5632	85.6			5632	90.8			5632	100.0		
TCC			5180	82.2			5180	74.7			5180	72.0			5180	68.4
HVY CC			364	5.8			364	5.2			364	5.1			364	4.8
Polymer			755	12.0			755	10.9			755	10.5			755	10.0
Ther-Ref			0	0.0			637	9.2			892	12.4			1274	16.8
HVY SR	1900	25.2			950	14.4			570	9.2			0	0.0		
TOTAL	7532	100.0	6299	100.0	6582	100.0	6936	100.0	6202	100.0	7191	100.0	5632	100.0	7573	100.0
COMPOSITION BASED ON REFINERY STREAMS																
LT SR	5457	72.4			5457	82.9			5457	88.0			5457	96.9		
TCC			5019	79.7			5019	72.4			5019	69.8			5019	66.3
HVY CC			323	5.1			323	4.6			323	4.5			323	4.2
Polymer			755	12.0			755	10.9			755	10.5			755	10.0
Ther-Ref			0	0.0			625	9.0			874	12.1			1249	16.5
HVY SR	1670	22.2			835	12.7			501	8.1						
"B-B"	405	5.4	202	3.2	290	4.4	214	3.1	244	3.9	220	3.1	175	3.1	227	3.0
TOTAL	7532	100.0	6299	100.0	6582	100.0	6936	100.0	7191	100.0	5632	100.0	5632	100.0	7573	100.0

Figure 13—Compression ratio and octane number developments have been in step in the past.

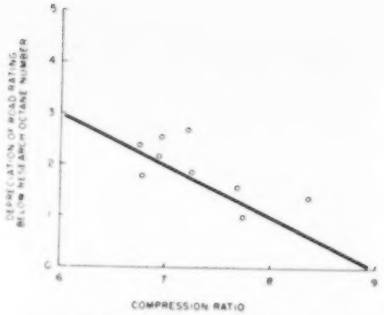


Figure 14—Effect of compression ratio on road octane depreciation of commercial gasolines.

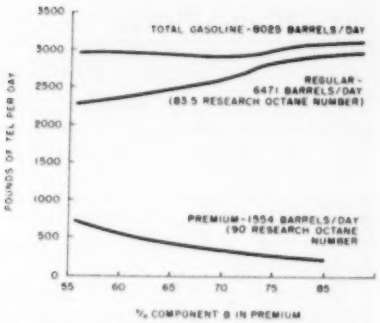

TOTAL GASOLINE - 9029 BARRELS/DAY
REGULAR - 6471 BARRELS/DAY (83.5 RESEARCH OCTANE NUMBER)
PREMIUM - 1554 BARRELS/DAY (90 RESEARCH OCTANE NUMBER)
POUNDS OF TEL PER DAY
% COMPONENT B IN PREMIUM

Figure 15—TEL requirement for desired research octane number.

octane number, and TEL content they may still differ appreciably in road rating. This is because operating conditions in the laboratory engine differ from those prevailing on the road, and gasolines respond differently to the changes in test conditions. Such differences can be ascribed only to differences in "hydrocarbon composition" of the gasolines. Attempts to characterize "hydrocarbon composition" in terms of simple tests such as percent aromatics or percent olefins have not yet been successful.

Road octane ratings also vary with car make and model, so it is important to rate a gasoline in appropriate test cars. Variations among cars that can affect road rating include carburetor characteristics, design of combustion chamber, type of transmission, and compression ratio. That gasoline quality and compression ratios have been generally in step in the past is shown in Figure 13. The effect on road rating of gasolines with increasing compression ratios is illustrated in Figure 14. It can be seen that an increase in compression ratio tends to minimize the road depreciation effect. In other words, the road rating tends to approach closer to the Research octane number with an increase in compression ratio. The points shown are a combination of both duPont's Petroleum Laboratory data and Coordinating Research Council octane requirement survey data. The slope of the line is based on fuel rating data obtained in General Motors Research engines.

Road Testing of Motor Gasolines—For a refiner to make use of the general correlations of laboratory data with road performance, the extent and reliability of these correlations have to be established experimentally. The continuing increase in motor gasoline octane numbers make it highly desirable for a refiner to be able to road test his product in order to assess properly all variables and make optimum use of his stocks. Complete instrumentation for a test car might cost as much as $6500. To road rate gasolines for octane levels only, a minimum amount of instrumentation is required. This can be installed for as little as $500. A planned and continuing program of fuel road testing could lead to economic savings and improvements in product quality not otherwise being realized.

Maximum Usage of Available Gasoline Stocks—In many cases a given set of laboratory specifications can be met by use of different blending schemes. Due to peculiarities in octane blending values of gasoline components, unexpected advantages can sometimes be obtained by a change in the blending scheme used. Based on a limited amount of accumulated data, there appears to be little, if any, blending bonus from catalytic reformate when mixed with either cracked or straight run products.

One method for locating the optimum blending procedure results in curves such as those in Figure 15. This shows a range of blending within which lead usage is at a minimum. Conversely this also defines the range in which most potential Octane increase through use of TEL remains. This type of study has been found to be of sufficiently general interest, that is thought worthwhile to go through the development steps leading to the final curve.

Stream quantities, ratio of Premium to Regular, octane levels, TEL limits if any, distillation and vapor pressure specifications, define the overall problem.

It has been found that minimum lead dosage can generally be determined by blending all the stocks into two components. One component, "B," is made up of all cracked, or olefinic streams, in the ratio of their production. In this is included cracked gasolines, from the catalytic and thermal units, and polymer gasoline, vapor pressured with refinery spent butane fraction, and natural gasoline if this is required. The other component, "A,"

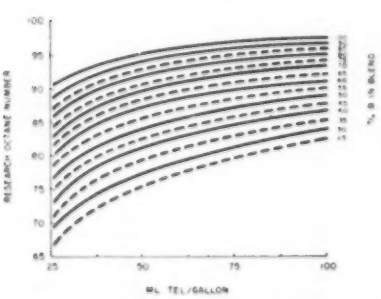


Figure 16—Blending chart for gasolines containing various percentages of Component B in blends of Component A and Component B.

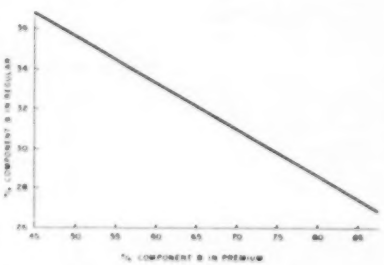


Figure 17—Possible variations of Component B in premium and regular gasolines.

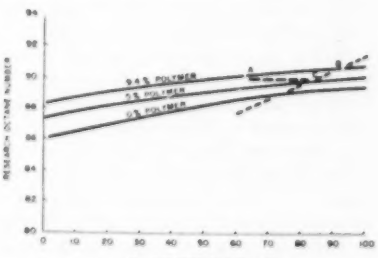


Figure 18—Research octane numbers on blends of light pressure distillate and light straight run without and with varying concentrations of polymer gasoline. (Containing 3.0 Ml. TEL per gallon).

is made up of light and heavy straight run gasolines, vapor, pressured with the remaining spent butane fraction and natural gasoline. Where relatively small quantities of unusual stocks, such as coker gasoline or low octane thermal, are involved, these can be shifted from one grade to the other in final blends.

The components are blended as in Table 1, and lead susceptibilities determined as shown.

Curves of octane number versus TEL content are then drawn for the various blend ratios. These are shown in Figure 16. Octane numbers of intermediate compositions are determined from curves of Octane number versus composition at each lead level. A relationship of composition versus grade is determined as in Figure 17. From these two sets of curves, a tabulation as in Table 2, is made up. This fixes limiting conditions as well as intermediate points for determining the blending schedule which gives the optimum lead usage. In this particular study, because of the operating conditions of stabilizing the light straight run and thermal gasolines together, these were handled as one combined stream. This stream together with heavy straight run naphtha and natural gasoline made up component "A." Catalytic cracked and polymer gasolines plus some B-B and natural gasoline made up component "B."

This study determined that through selective blending, an appreciable saving in lead costs could be made.

Another example of the application of blending studies was an investigation to determine the amount of polymer gasoline required to make both a specified Research and Motor octane gasoline from blends of light straight-run and light pressure distillate. This resulted in the curves shown in Figure 18. The dotted line represents the limiting blends for the specified Motor octane number. The area enclosed by the points A, B, and C defines the range of blend compositions possible which met all the desired specifications.

Still a third example was the problem of determining the extent to which thermal reforming would have to be done to meet minimum gasoline octane requirements. This resulted in a series of blends of the various refinery stocks shown in Table 3. These components were then tested as illustrated in Table 4. From a series of curves such as is shown in Figure 19 for each blending case, Table 5 was developed. This not only determined the minimum thermal reforming required to make desired Octane Numbers, but in each case, minimum lead requirement was defined.

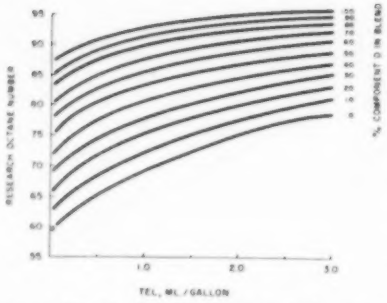


Figure 19—Blending curves for producing gasolines from Components C and D. Case II.

Summary—Resorting to the freedom of interpretation—which each engineer feels is his God-given right—an estimate of future gasoline octane levels has been made. This was compared with estimated future car requirements current with the forecast gasolines. General correlations of Research octane number, Motor octane number, TEL levels, and gasoline composition with road octane values have been demonstrated. It is believed that a refiner, by a planned program of laboratory and road testing of his products, can develop these relations specifically for his own operations. When once these have been established, optimum usage of his stocks is assured. This, at least, will place his operations in the best possible quality competitive position.

TABLE 4

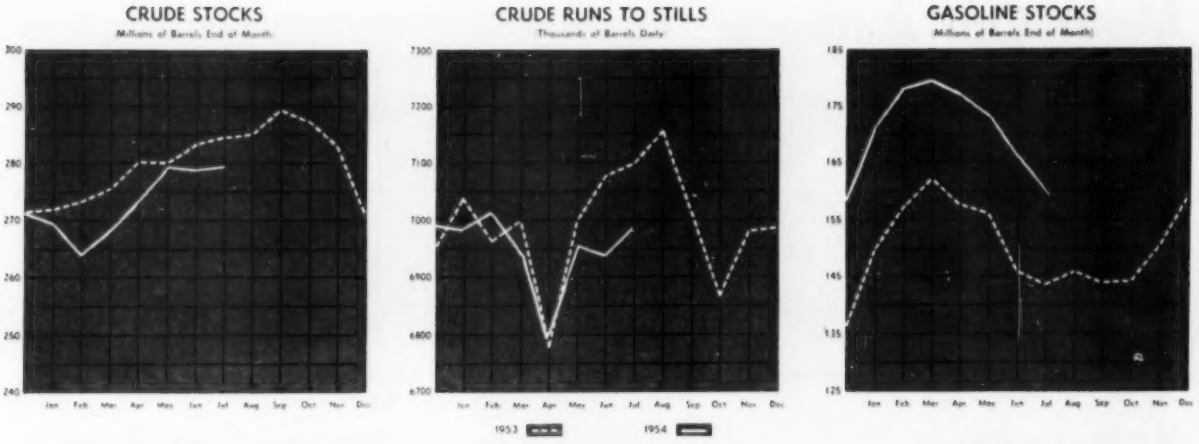
TEL Response Data on Blends
Prepared From the Two Blending Components for Each of Four Cases

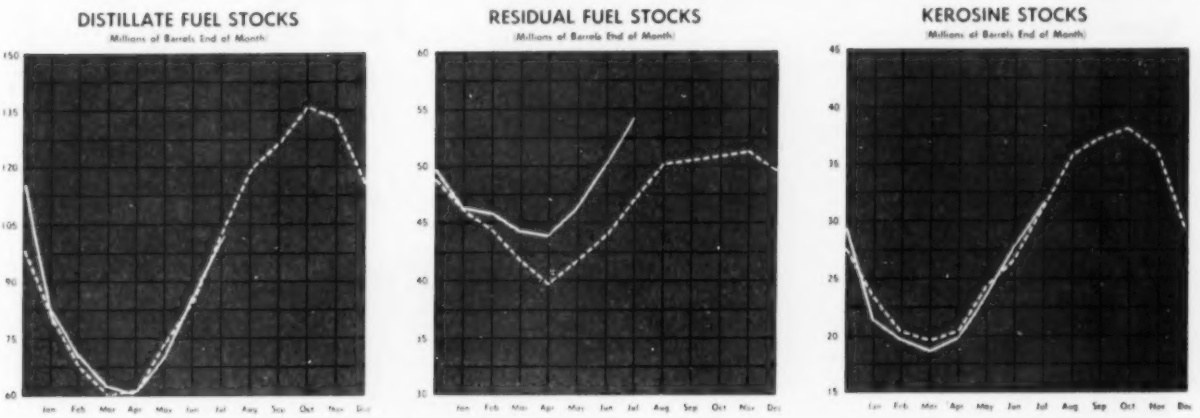
	RESEARCH OCTANE NUMBER ML. TEL/GALLON			
	0.9	1.0	2.0	3.0
Case I (No Thermal Reforming)				
100 Percent A	57.3	66.8	73.2	77.0
75 Percent A + 25 Percent B	66.0	75.4	80.7	83.7
50 Percent A + 50 Percent B	74.2	82.6	86.4	88.6
25 Percent A + 75 Percent B	81.5	88.4	91.1	92.7
100 Percent B	87.7	92.6	95.1	96.1
Case II (50 Percent Thermal Reforming)				
100 Percent C	59.5	69.2	75.0	78.5
75 Percent C + 25 Percent D	67.0	76.7	80.9	84.0
50 Percent C + 50 Percent D	74.4	83.2	86.5	88.9
25 Percent C + 75 Percent D	80.0	88.1	91.2	92.7
100 Percent D	86.9	92.5	94.4	95.8
Case III (70 Percent Thermal Reforming)				
100 Percent E	60.2	70.8	75.4	79.2
75 Percent E + 25 Percent F	68.2	77.3	81.5	84.0
50 Percent E + 50 Percent F	75.4	83.0	86.6	88.6
25 Percent E + 75 Percent F	81.3	88.4	91.2	92.6
100 Percent F	86.5	92.4	94.8	96.0
Case IV (100 Percent Thermal Reforming)				
100 Percent G	62.0	72.0	77.2	81.0
75 Percent G + 25 Percent H	70.3	78.5	82.9	85.4
50 Percent G + 50 Percent H	76.1	83.2	87.1	89.3
25 Percent G + 75 Percent H	80.9	88.0	91.3	92.6
100 Percent H	85.5	92.3	94.3	95.2

TABLE 5

Daily Tetraethyl Lead Requirements As Developed Under Each of the Four Blending Cases

GRADE	Desired Res. Oct. No.	Barrels Per Day	Percent High-Octane Component In Blend	TEL REQUIREMENT Ml. TEL/ Gallon	Lb. TEL	Total Lb. TEL
CASE I (NO THERMAL REFORMING)						
Premium	93.0	3,458	Desired Octane number for both grades of Gasoline			
Regular	87.0	10,373	Cannot be Attained with no Thermal Reforming.			
CASE II (50 PERCENT THERMAL REFORMING)						
Optimum Blending Procedure						
Premium	93.0	3,380	80.0 % D	2.72	1405	5819
Regular	87.0	10,138	41.8 % D	2.85	4414	
"Special" Blending Procedure						
Premium	93.0	3,380		2.75	1420	5788
Regular	87.0	10,138		2.82	4368	
CASE III (70 PERCENT THERMAL REFORMING)						
Premium	93.0	3,348	90.0 % F	1.81	927	5520
Regular	87.0	10,045	41.6 % F	3.00	4602	
Premium	93.0	3,348	85.0 % F	2.28	1167	5309
Regular	87.0	10,045	43.3 % F	2.70	4142	
Premium	93.0	3,348	80.0 % F	2.75	1408	5320
Regular	87.0	10,045	44.9 % F	2.55	3912	
CASE IV (100 PERCENT THERMAL REFORMING)						
Premium	93.0	3,301	100.0 % H	1.33	670	4226
Regular	87.0	9,904	43.1 % H	2.55	3556	
Premium	93.0	3,301	95.0 % H	1.68	847	4251
Regular	87.0	9,904	44.8 % H	2.25	3404	
Premium	93.0	3,301	90.0 % H	1.96	988	4286
Regular	87.0	9,904	46.5 % H	2.18	3298	
Premium	93.0	3,301	85.0 % H	2.37	1194	4301
Regular	87.0	9,904	48.1 % H	2.06	3107	
Premium	93.0	3,301	80.0 % H	2.86	1441	4437
Regular	87.0	9,904	49.8 % H	1.98	2996	




DISTILLATE FUEL STOCKS
(Millions of Barrels End of Month)
RESIDUAL FUEL STOCKS
(Millions of Barrels End of Month)
KEROSINE STOCKS
(Millions of Barrels End of Month)

Taking Stock

Cecil W. Smith
Economics Editor

(DATA IN THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		KEROSINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1952:													
October	6,518	6,883	269,776	3,301	120,062	352	33,289	1,458	120,721	1,293	53,052	643	1,038
November	6,487	7,049	267,852	3,416	129,509	393	32,199	1,510	116,096	1,299	53,099	624	984
December	6,634	6,952	271,928	3,361	136,028	421	26,842	1,509	99,582	1,302	48,706	603	1,165
1953:													
January	6,555	7,042	272,250	3,384	150,518	433	23,292	1,528	80,655	1,307	45,910	616	1,135
February	6,562	6,969	273,589	3,379	157,873	404	20,468	1,505	67,167	1,275	44,178	586	1,066
March	6,531	7,002	275,665	3,319	162,731	359	18,697	1,489	59,802	1,256	41,600	675	1,112
April	6,446	6,781	280,487	3,282	158,032	361	20,335	1,424	61,349	1,219	39,572	628	1,010
May	6,390	7,002	280,308	3,366	156,415	327	24,307	1,400	73,706	1,197	41,795	703	1,096
June	6,595	7,081	283,715	3,467	146,196	326	27,679	1,462	84,504	1,238	43,801	707	1,050
July	6,603	7,103	284,976	3,583	143,916	321	31,143	1,441	102,258	1,224	47,530	629	950
August	6,583	7,163	285,352	3,592	146,050	321	35,711	1,437	119,542	1,222	50,007	672	946
September	6,557	7,023	289,614	3,521	144,184	330	37,280	1,448	126,709	1,203	50,516	692	1,013
October	6,262	6,872	287,541	3,437	144,495	355	38,161	1,462	135,409	1,184	50,820	639	990
November	6,277	6,987	283,021	3,528	150,747	354	36,271	1,463	133,381	1,223	51,267	648	1,120
December	6,238	6,964	276,676	3,628	159,949	378	29,070	1,441	111,944	1,247	49,370	598	1,121
1954:													
January	6,240	6,947	270,811	3,431	171,704	390	22,013	1,467	81,044	1,271	47,474	617	1,143
February	6,379	7,068	266,918	3,476	179,950	412	20,183	1,545	70,390	1,241	47,119	621	1,144
March	6,507	6,923	271,867	3,375	181,297	353	17,533	1,458	60,270	1,168	44,249	654	1,088
April	6,615	6,811	280,310	3,404	177,006	322	19,656	1,374	61,721	1,140	44,362	574	950
May	6,471	7,038	282,250	3,482	177,606	302	23,892	1,372	73,581	1,148	47,009	708	1,021
June	6,500	6,947	285,155	3,483	165,404	306	28,184	1,399	86,325	1,123	50,216	624	999
July	6,282	6,922	279,744	3,378	158,174	305	31,535	1,412	101,101	1,108	54,735	686	1,011
Week Ended:													
8-20-54	6,156	6,936	277,788	3,404	155,017	310	33,830	1,466	111,444	1,131	55,848	665	932
8-21-53	6,619	7,109	282,758	3,523	140,511	310	33,227	1,463	113,302	1,279	50,844	577	823

Source: Data for last two months from API; prior monthly data from Bureau of Mines.

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Maples Vacationing After Recent Trip From Brazil

Robert E. Maples, "Gasoline Blending Stocks," page 284.

Right now Robert E. Maples is vacationing in the U. S. with his wife and two children. His respite comes on the heels of his recent resignation from Conselho Nacional do Petroleo, a Brazilian government agency.

A former instructor in chemical engineering and petroleum refining at the University of Tulsa, Maples went to Rio de Janeiro in 1952 to assist in organizing and conducting a course in refinery engineering patterned after the University of Tulsa course.

Not only is Maples a former instructor at Tulsa; but he is also a graduate of the school. He received a B.S. degree in chemical engineering in 1941. Soon thereafter he joined Phillips Petroleum Company at its Borger, Texas, refinery, where he did research and development work on such projects as crude desalting, hydrogenation of codimer, and the effect of mercaptan content on TEL susceptibility of refinery blend stocks. After a hitch with the U. S. Army Weather Service, he returned to the University of Tulsa, received an M.S. degree in petroleum refinery engineering, and duplicated his earlier path by joining Phillips at its Borger refinery as a process engineer. He joined the staff at the University of Tulsa in 1950, was there two years before trekking to Rio de Janeiro.

Robert E. Maples

Ellis Gets Idea for Paper From Students

S. R. M. Ellis, "The Short-Cut Feed Plate Location Method," page 307.

As senior lecturer in the Chemical Engineering Department of the University of Birmingham, Edgbaston, Birmingham, England, Dr. S. R. M. Ellis supervises design problems and some of the research work in the department in addition to lecturing.

It was from this work that the idea to write this article emanated, the undertaking arising out of students' design problems and the apparent need for a short-cut method.

Dr. Ellis has not always been a teacher. He has over 12 years industrial experience in the operation and design of chemical plants, including two years as a laborer and shift operator on fertilizer and low temperature carbonization plants.

Dr. Ellis was born at Dunedin, New Zealand. After receiving his early education in that country and working a couple of years in industry, he sailed for England in 1937. Ten years of industry work later, he visited New Zealand, returning one year later to England and to the University of Birmingham to stay. He and his wife are a living refutation to the old saw that ". . . never the twain shall meet;" Mrs. Ellis is Manx, from the Isle of Man. Educated at Liverpool University, she has developed a career of her own as an architect.

Cromwell Company Service Broken by Army Service

Clyde E. Cromwell, "When to Replace a Pump," page 300.

Except for a four-year hiatus (1942-46) spent with the U. S. Army Corps of Engineers, Clyde Cromwell has been with De Laval Steam Turbine Company ever since being graduated from Rose Polytechnic Institute with a B.S. degree in mechanical engineering in 1937.

He has been a sales engineer, contract engineer, and a district manager. Since 1951 he has been sales manager of the company's Commercial division.

Michigan Group Turns Out Another Top Article

Donald L. Katz, Edwin H. Young, Richard B. Williams and Garen Balekjian, "Cooling Fluids with Finned Coils," page 303.

On numerous occasions, research projects at the University of Michigan have been written up in excellent articles, many of which have been published in PETROLEUM REFINER. Another one of those articles is contained in this issue.

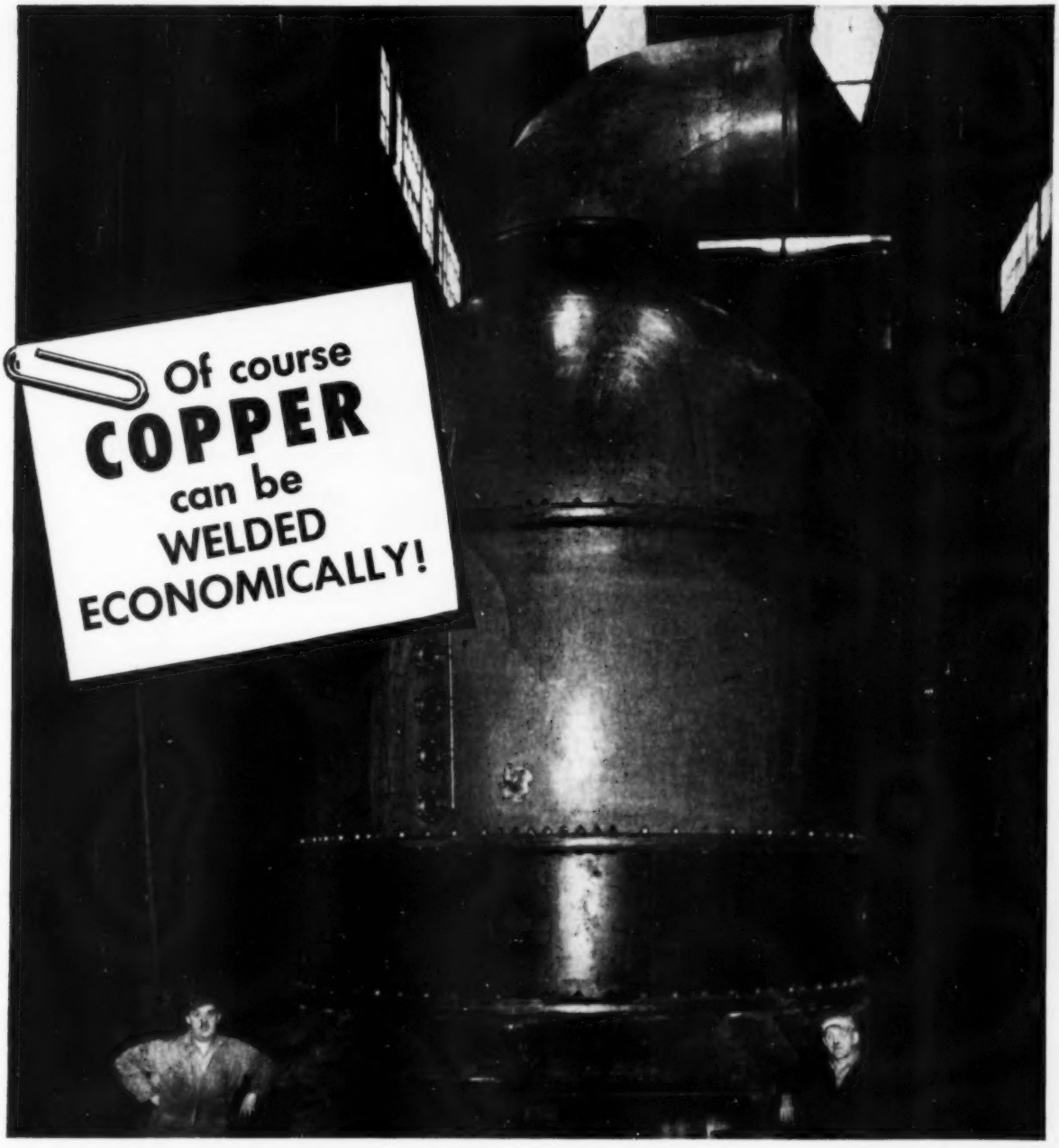
Behind "Cooling Fluids with Finned Coils" is the foursome which worked on the initial project at Michigan.

Donald L. Katz, professor of chemical engineering and chairman of the Department of Chemistry and Metallurgical Engineering at Michigan, was born in Jackson County, Mich., and has since never been far away from that area for an extended period. He received a Ph.D. degree from Michigan in 1933, going from there to the Research department at Phillips Petroleum Company. After three years he returned to the University as assistant professor of chemical engineering. During his 18 years at the school he has published over 100 technical papers on the general subject of petroleum and heat transfer. He received the Hanlon Award from Natural Gasoline Association of America in 1950.

Edwin H. Young is assistant professor of chemical engineering at Michigan, a post similar to that which Katz held when he first joined the Michigan faculty. Young, who has been on the faculty seven years, received his bachelor's degree in chemical engineering from the University of Detroit in 1942. Afterwards he gained experience in engineering design offices. His teaching specialty is equipment design. He is presently directing several studies on heat transfer through finned tubes.

Since 1951, Garen Balekjian has been a graduate student at Michigan, working towards a doctorate and employed part-time in the Engineering Research Institute doing research on heat transfer through finned tubes. Born in Cairo, Egypt, he received a B.S. degree in science and mathematics from the American University at Cairo in 1948, a B.S. degree in chemical engineering from the University of Texas in 1951, and a master's degree from Michigan in 1952.

At this time, neither picture nor biographical data is available on Richard B. Williams, who was one of the graduate students working on the project.



The joints in this copper Vacuum Pan with calandria were welded quickly and economically and perfectly by the automatic inert-gas shielded metal arc method. Philadelphia Coppersmithing Co., Philadelphia, Pa., did it. You, too, can weld copper the same way. The pan, 12′7″ diameter was made for a large sugar refiner, and has a breast of 11/16″ deoxidized copper, quite heavy by usual standards. Due to the thickness, and the welds, the coppersmith and the refiner expect the new vessel to last for 100 years.

It replaces one made by the same company in 1913, out of 7/16″ copper with brazed joints. Since it operates under a vacuum of 28″, the sugar people began to worry about possible thinning of the wall. A hole was drilled in the copper, and the gauge measured; it was found that in 40 years only 1/16″ of copper had been lost. This is all the more remarkable because the pan had been cleaned at least once a week with strong acid. Copper certainly does resist corrosion!

It is believed that this is the first, or one of the first pans of its kind to be welded instead of brazed. If you have questions regarding the economical and speedy welding of copper, come to Revere. See the nearest Sales Office.

VACUUM PAN of Revere Deoxidized Copper, fabricated by Philadelphia Coppersmithing Co., for a large sugar refiner. Seams are welded. Expected life, 100 years. Contains more than 28,000 lbs. of Revere Sheet Copper and Copper Tube.

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Reviewing New Books . . .

Writing and Using Reports

The Technical Report, edited by B. H. Weil, Reinhold Publishing Corporation, 430 Park Avenue, New York 22. $12.

Technical report writing has become a tool of modern industry. Its evolution is one of the most significant of recent developments in the field of research and development in its use for disseminating findings. Courses on the writing of such reports are found in almost every engineering school.

This new book, edited by B. H. Weil, manager of information services, Department of Research and Engineering, Ethyl Corporation, adds a "plus" to the usual look at reoprt writing. Unlike most books on reports which treat writing almost exclusively, Weil's volume goes into fundamentals of editing, illustrating, duplicating, binding, distribution, security, filing and putting report files to work. The writing of reports, however, is also discussed, with emphasis on successful procedures and on specific types of reports.

Report writers, technical editors, graphic art groups, research and technical personnel connected with technical communication will find this a handy book to have around.

Standards for Safety

Handbook of Industrial Safety Standards. Ninth Edition, Association of Casualty & Surety Companies, 60 John Street, New York 38. $1.40.

This revised edition of a handbook which has become a standby in its field during the last 30 years includes new chapters, illustrations, and tables and is 50 percent larger.

Compiled in the work are industrial safety requirements recommended by nationally recognized authorities. Much of the text material is an amplification and extension of the various codes on which it is based, while some sections deal entirely with topics not covered by any existing standard.

Subject matter includes: safety programs, accident investigations, materials handling, boilers and unfired pressure vessels, machine guarding and other hazardous operations.

Industry Directory

Allen's Personnel Directory of the Chemical and Oil Industries. Fifth Edition, 1954, H. D. Allen, 1265 Commercial Trust Building, Philadelphia 2. $30.

In its 235 pages, this directory gives the names and titles of more than 20,000 key men in the chemical plant and oil refineries who control buying and specifying of equipment and services. Personnel in companies in both the U. S. and Canada are included.

A total of 1800 separate companies are listed alphabetically by states and in a complete company index. Personnel listed are presidents, superintendents, purchasing agents, chief chemist, and laboratory men. Products manufactured by the companies and trade names used are also covered.

Deaerating Units

Standards and Typical Specifications for Deaerators and Deaerating Heaters, Heat Exchange Institute, 122 East 42nd Street, New York 17. $1.

In this new edition of a previous document on deaerators and deaerating heaters, all material has been revised and rearranged. A new addition is a table which gives storage in minutes and cubic feet for tabulated capacities from 10,000 pounds/hour to 1600 pounds/hour. Tables on shell and head thicknesses have been revised and expanded, as has the table on accessories selection and standard opening sizes.

This new book contains a chart showing flow through valves in pounds per hour and tables giving temperature-pressure conversion from 140 F. to 212 F. and pressure-temperature from 0 to 125 psig. Diagrams have been added showing typical arrangements of deaerating units.

Charted Solutions

Plant Engineer's Easy Problem Solver, Louis J. Murphy, Conover-Mast Publications, Inc., New York. $6.

Charts for simple and rapid solution of many types of engineering problems are presented in this book for the engineer's daily chore of solving problems involving the use of equations, constants, empirical data or test results. This is a practical book dealing with the shortest and quickest way of going from raw data to the accurate solution of an equation involving these data. It is a horizontal book, cutting across industry without regard to the eventual use of the answers it gives. What the user of this book will find is a minimum of text, a maximum of illustrations. Where exceptions to general rules occur, they are pointed out; however the reader must evaluate such exceptions in terms of his own problems.

Containers and Pallets

Standard Specifications for Containers and Pallets, Packaging Institute, 342 Madison Avenue, New York 17. $1.

This report on specifications recommended by the Petroleum Packaging Committee of Packacing Institute covers the following:

- Specification for 1-quart Round Motor Oil Cans (an American Standard).
- Recommended Standard Specifications for 5-quart and 1-gallon Round Cans.
- Recommended Standard Specifications for Oblong Cans
- Recommended Specifications for 120-pound or 16-gallon (U. S.) Full Removable Head Universal Grease Drum.
- Recommended Standard Dimensions for 1-pound and 5-pound Multiple Friction and 5-pound Full Friction Grease Cans.
- Recommended Standard Specifications for Export Shipping Cases.
- Recommended Specifications for an Expendable Pallet for Shipping Petroleum Waxes.
- Tentative Standards for Reconditioned Steel Drums.

Gaseous Fuels

ASTM Standards on Gaseous Fuels. American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. $2.50.

All of the ASTM test methods used in the field of gaseous fuels are contained in this 1954 edition. Sponsored by the ASTM Committee D-3 on Gaseous Fuels, the test methods cover: measurement of gaseous fuel samples; sampling (natural gas; manufactured gas; liquefied petroleum gases); analysis (of natural gases by the volumetric-chemical method; natural gases and related types of gaseous mixtures by the mass spectrometer; carbureted water gas by the mass spectrometer); gaseous fuels (water vapor content, by measurement of dew-point temperature; calorific value, by the water-flow calorimeter; specific gravity); sulfur in petroleum products and liquefied petroleum gases by the CO_2-O_2 lamp method; vapor pressure of liquefied petroleum gases.

Material Selection

Corrosion Data Survey, 1954 Edition, Shell Development Company, Emeryville, Calif. $35.

This comprehensive book will help designers choose the most desirable material of construction for certain equipment. Available corrosion data are widely scattered through technical papers and manufacturer's literature; this book fills the need for one central source. An endeavor has been made to summarize reported data in a group of charts for ready reference in order that feasible metals may be quickly determined. These charts act only as a guide and it is expected that in many cases corrosion tests and pilot plant experience may be necessary. However the charts have been checked against actual plant conditions and a good correlation has been found. The first sixty charts in the book include the corrosion rates of the most common chemicals in relation to 31 different materials of construction.

More detailed information is given for corrosion of steel by sulfuric acid, corrosion resistance of materials to sulfuric acid, corrosion resistance to hydrochloric acid, corrosion of steel by mixed acids, corrosion resistance of materials to mixed acids, operating methods for carbon and alloy steels in contact with hydrogen at high temperatures and pressures, and corrosion of metals by carbon monoxide at high pressure in the presence of hydrogen.

The Chemical Business

Chemical Business Handbook, John H. Perry, editor-in-chief, McGraw-Hill Book Information Service, 327 W. 41st Street, New York 36. $17.

A wide range of modern business management methods and practices, treated especially for their interest to the chemical and chemical engineering industries, are thoroughly covered in this new book in which 125 leading authorities discuss their fields of specialization.

Consisting of 20 sections, the book covers such phases of business operation as finance, and control by cost accounting, to sales, and advertising. A host of other subjects make the book practically a business encyclopedia for the chemical industries.

Many processes are available to the refiner who is projecting a refinery from a given crude. The selection of these various processes at each step of the way is obviously important — both economically and to meet required product specifications.

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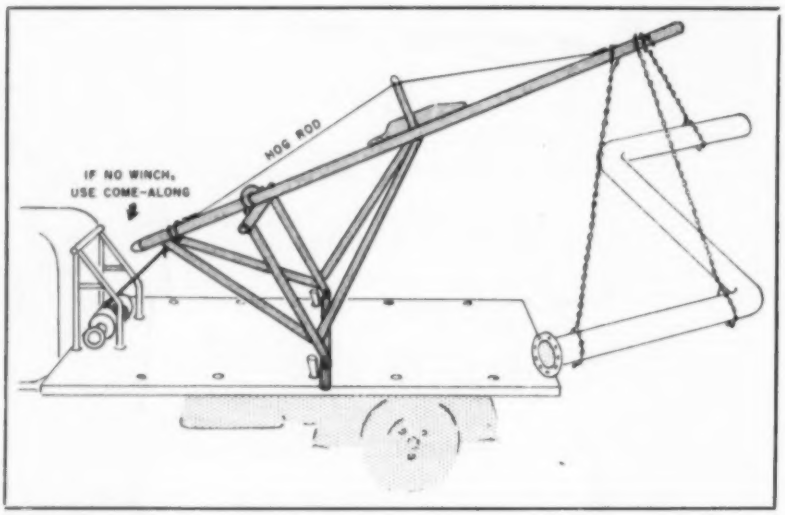
How to Do It . . .

Demountable Rocker Boom Manipulates Heavy Loads



Turn an ordinary flat-bed truck into the equivalent of a gin-pole truck with an easy-to-make rocker boom that will pick up loads almost as heavy as those handled by gin poles. The cost is little; the advantages are many.

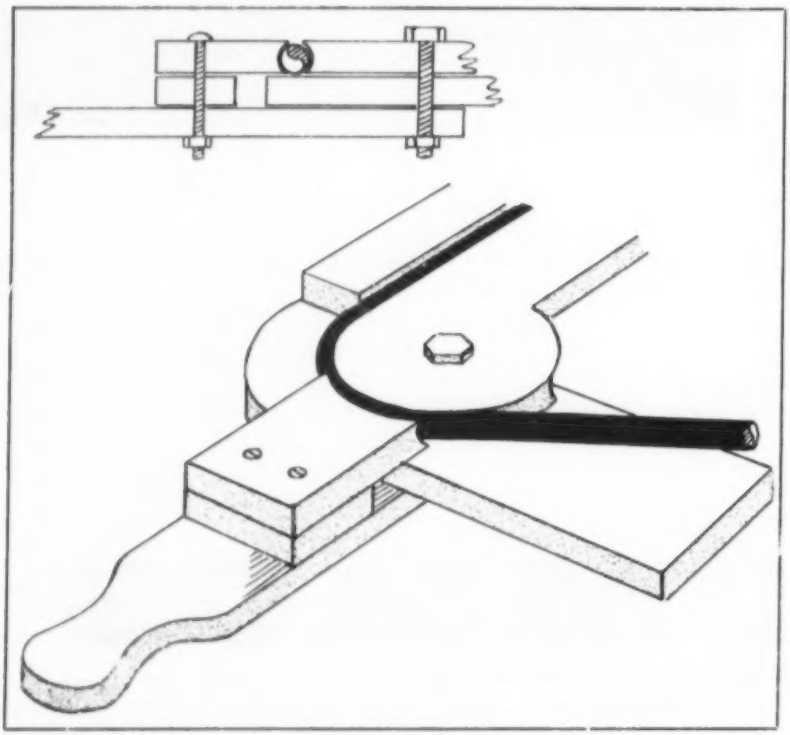
As a rule, flat-bed trucks suffice for station maintenance forces. They are adequate for transporting men and light materials about the station yard, and hauling parts from the depot. Yet, on occasions, there are loads too heavy for men to handle, and loading equipment is not at hand. This is when the rocker boom, shown at right, comes in handy.

The boom assembly is demountable—is not a part of the truck. To install it on the truck, it is necessary only to drive two body stakes in place as shown, and lift the boom onto the truck. Then hook the short end of the pole to a winch if the truck is equipped with one. A "come-along" or coffin hoist will serve almost as well as a winch.

The design of the boom assembly varies according to size of truck and weight of the loads to be lifted. For a 2½-ton truck the long pole should be made of 4-inch pipe, with a framework of 3-inch pipe. A strong-back of half-inch steel plate and a hog rod brace running from end to end of the pole gives it added strength.

Care should be taken to make the pivot strong enough to avoid shearing. One way to do this is to weld small diameter pipe sleeves into the pipe for the heavy bolts that attach the boom to the bottom plate which rests on the truck bed. Heavy steel clips support the assembly.

Of course, if the bottom member of the assembly is made of heavy pipe, it will roll against the body stakes as the boom pivots.



Hardwood and Bolts Can Be Copper Tubing Bender

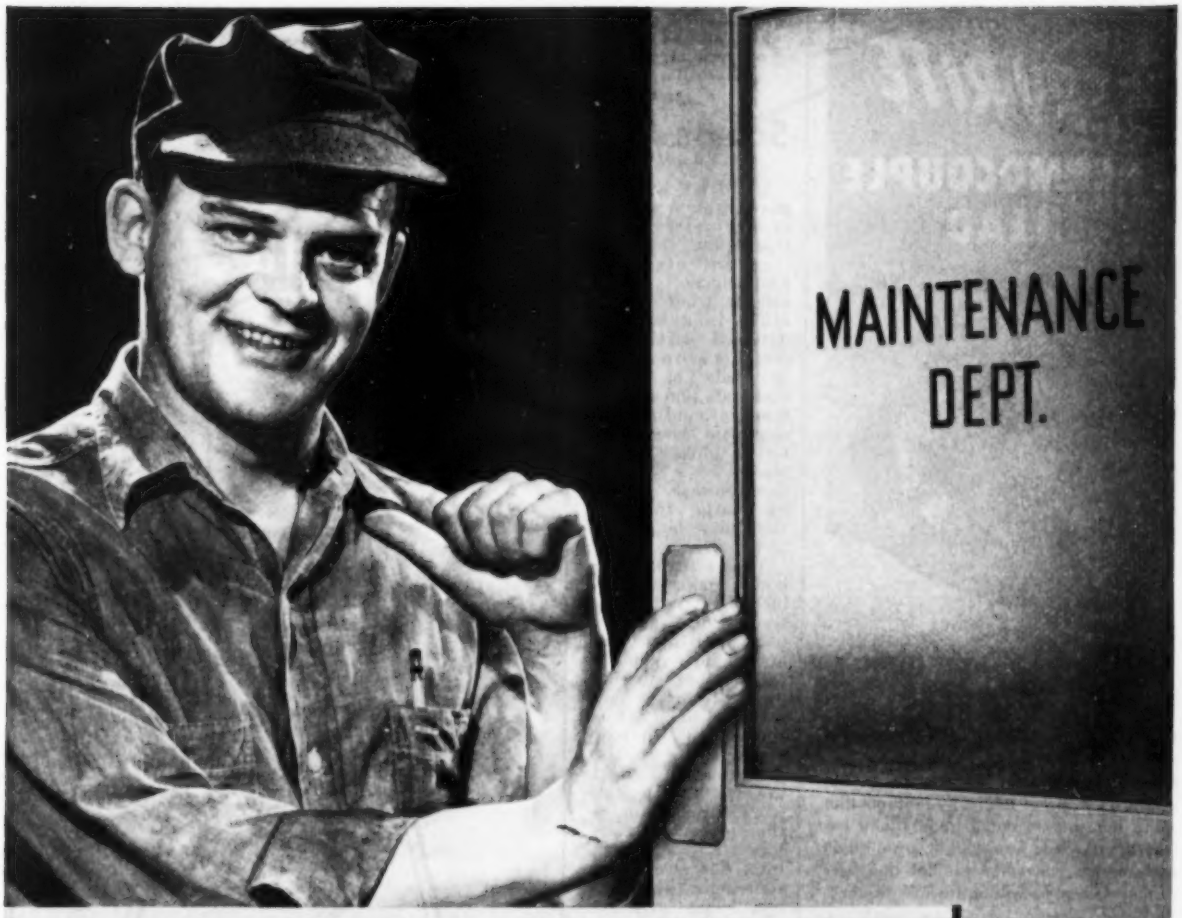
It's easy to make a copper tubing bender, which can also handle small diameter pipe, from hardwood and a few bolts. The bender which is pictured above, has proved satisfactory; it will not flatten the tubing as it bends it and, more important, it will not scratch it.

The bender has three main parts: the back-up ring, the handle and the dog that pulls the tubing around the back-up ring. The back-up ring can be cut on an ordinary wood lathe. Its radius should be that of the bending radius of the copper tubing and the circular groove in the outer edge should fit the tubing.

The handle bolts onto and pivots from the center of the back-up ring. Attached to it is the dog, which actually makes the bend. This dog must be grooved to fit the pipe tightly as the bend is being made. Its friction with the tubing prevents kinking by causing the outer edge of the tubing to stretch.

Note that there is a slot alongside the back-up ring which holds the straight portion of the tubing during the bend.

To make a bend, simply insert the



Me—I could write a buyer's guide!

When it comes to equipment, you can't fool maintenance men. They know what stands the gaff—and what doesn't. They also know a lot of their work is due to faulty selection of equipment —mistakes in judgment of quality, mainly.

In buying valves, such mistakes usually happen when someone buys on price alone, or because "all valves look alike." In either case, today's penalty is excessive maintenance at the highest labor rates in history. And where valve trouble causes production loss, it, too, was never costlier.

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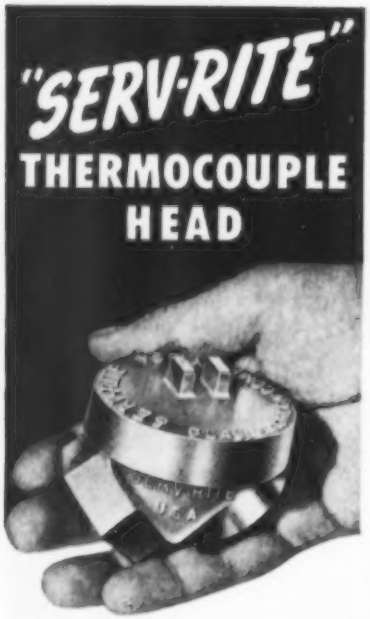

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This new "Serv-Rite" thermocouple head is actually small enough to be held comfortably in the palm of your hand. But size is only one of the many features that make this thermocouple head really extraordinary. It is loaded with installation and service conveniences that any user of thermocouples will appreciate at once.

The body is of malleable iron, cadmium plated for durability. A new type friction lock assures easy removal or tightening of the cap — a quarter turn does it. An asbestos gasket makes the head dirt- and moisture-proof. With a choice of ½", ¾", or 1" IPS opening for the protecting tube, you can standardize on one style head.

The connector block is of a material especially selected to withstand, without damage, temperatures up to 900° F. in continuous service. Improvements over the conventional type of inserts greatly simplify the making of the lead wire connections. The complete thermocouple element, including connector block, can be easily withdrawn for inspection.

Install a "Serv-Rite" thermocouple head and see for yourself how much better it really is.

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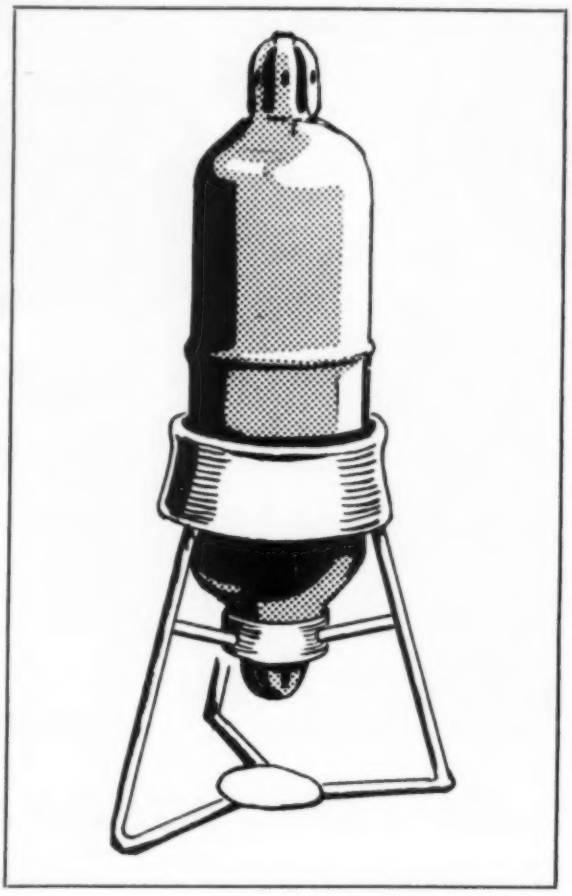
copper tubing into the slot and turn the handle around until the proper number of degrees have been reached. To handle different sized tubing, different size dogs and back-up rings must be substituted for the original ones.

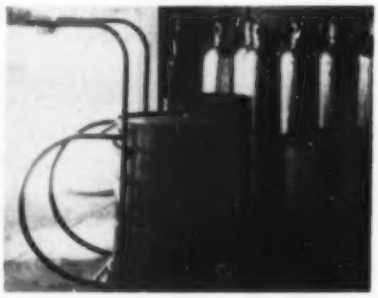
Scraps Make Gas Sample Bomb Holder



Holding the big gas sampling bombs in an upright position while charging the contents to a Podbielniak column can be troublesome. Here is a holder designed specifically for this purpose. It is made of scrap materials that can be found around almost any plant. These materials plus a small amount of a welder's time can make it easy to charge the gas from these big bombs to the column.

The size of the bomb makes an 11-inch pipe thread protector ideal as the basic element of the holder. The supporting members for this protector are made from ½-inch reinforcing rod. The rods are fastened to the protector and bent inward 12 inches from the bottom of the protector. The legs are then welded to a flat steel plate four inches in diameter. This arrangement gives the rigidity necessary to support the weight of the bomb without any danger of having the bomb topple over. A ring with an inside diameter of 4½ inches is welded to the legs below the pipe thread protector using the ½-inch reinforcing rod. This ring fits over the bottom cap of the bomb and actually supports its weight while the pipe thread protector serves to hold the bomb upright. With the bomb in this position, the top cap can be removed and the charging line to the Pod column fastened to the valve at the top of the bomb. Painting the entire holder gives it a neat appearance.

This idea was submitted by W. F. Knighten, Jr., Carthage, Texas.



Simple Rack Gets Drums Into Horizontal Position

This simple rack aids in handling and dispensing the many different materials which are shipped in drums these days. This rack is designed so that it is an easy matter to get the upright drum into the horizontal position. It then serves the purpose of supporting the drum in this position so that the contents can be withdrawn. As shown in the photograph the rack is under the edge of the drum and is ready to be lowered into position so that the rockers

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The Davison Chemical Corporation has teamed with The Atlantic Refining Company in the development of a catalyst for reforming straight run and cracked gasolines to a product of higher octane level. Among the important tasks delegated to Davison was the translation of this catalyst from laboratory to commercial production and at the same time impart optimum selectivity, stability, ruggedness and regenerability.

Today, Davison is producing Atlantic Platinum Reforming Catalyst on a commercial scale and shipments are being made at an increasing rate to licensees of the Atlantic Catforming Process. Davison has an outstanding record of this type of development in many fields of commercial catalyst production. If you have a catalyst problem, see your Davison Field Service Engineer or write.

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For Tops in Pipe Wrench Performance...it's the Genuine RIDGID

...with the guaranteed trouble-free housing!

Only the RIDGID has a world-wide rep as the finest pipe wrench made. Only RIDGID has earned and maintains this rep by building toughness and smart performance into these overwhelmingly popular wrenches, checking them part by part and *hard work testing every last one* before shipment. When you buy a RIDGID, you know the housing won't break, the jaws won't slip or lock, the adjusting nut spins easily to all sizes, 6" to 60". Always most for your money—ask your Supply House.

Have you tried the new RIDGID Spud Wrench?

Deep narrow jaws for close work—break-proof housing — famous RIDGID jaw suspension — comfort-grip I-beam handle. Ask your Supply House.

THE RIDGE TOOL COMPANY, ELYRIA, OHIO, U. S. A.

RIDGID
Work-Saver Pipe Tools

How to Do It...

and the handles form the supports.

The framework of the rack is made entirely of ½-inch pipe. Two lengths about seven feet long are used as the basic supporting members. These form the horizontal supports and the handles. To these pipes are welded two other lengths of pipe that have been bent into the shape of rockers. Between the seven-foot lengths of pipe are welded four 2-inch metal straps which have been shaped to the contours of the drum. The drum actually rests on these straps. To aid in getting the drum into a horizontal position, a strip of metal is welded to the end of the rack. This strip slides under the drum and allows it to be tipped over. Once the drum has tipped into position, it is fastened to the rack with a chain (not shown).

Adjustable Clamp Firmly Anchors Process Piping

The illustration pictures a shop-fabricated dolly that is proving a strong right arm to the maintenance crew at an East Texas natural gasoline plant. Sturdily constructed of welded sections of 3-inch pipe, the dolly is equipped with a block and tackle for handling heavy equipment. Mounted on coasters, it can be easily moved to any part of the shop building.

Cash for Ideas

$10 is paid for each acceptable How to Do It contribution. Mail your ideas, with illustrations, to The Editor, PETROLEUM REFINER, P. O. Box 2608, Houston 1, Texas.

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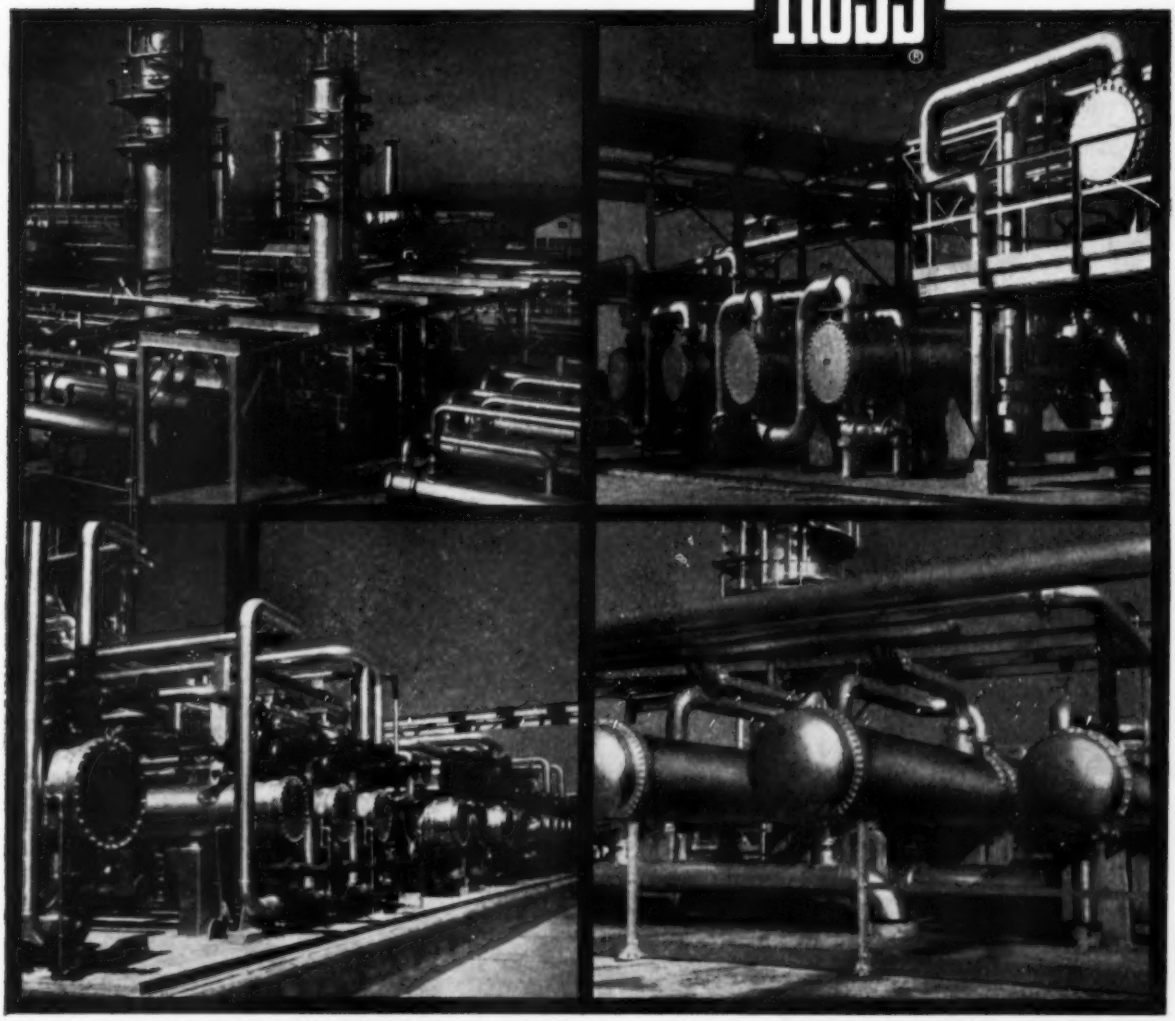

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PROVIDES Underwriters' Laboratories approval for all hazardous areas; only units approved for class I, groups A & B. (acetylene, hydrogen, manufactured gas)

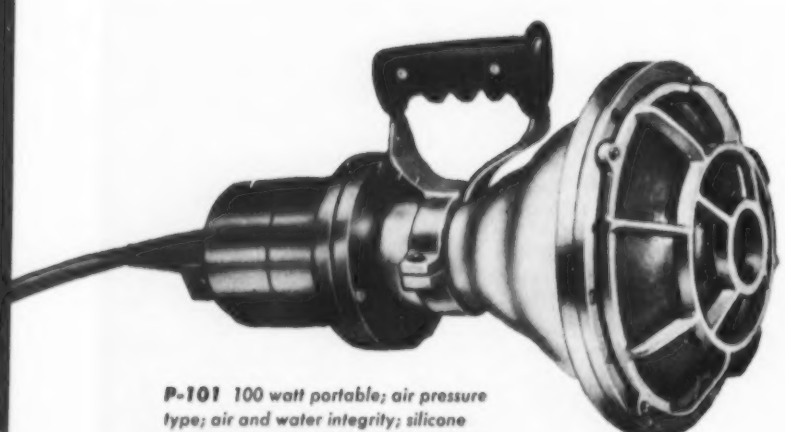
PROVIDES absolute, not relative safety. Only fully explosion-proof lighting available.

PROVIDES interior air pressure 15 psi greater than surrounding gas atmospheres and prevents entrance of any gas, paint vapors, dusts, etc. Air pressure is self-contained and lasts life of lamp.

ELIMINATES breathing and seepage occurring in all "explosion-proof" and "vapor-proof" units.

ELIMINATES explosions which occur by ignition of seeped-in gases, dusts, etc.

ELIMINATES explosions during moment of damage. Air Pressure units extinguish automatically at 3 ½ psi.



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PS-102 *200 watt portable on stand*

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  and other petrochemicals involving any hydrogen

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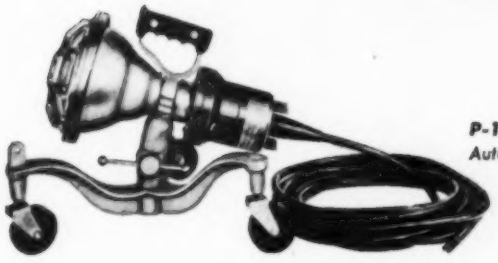

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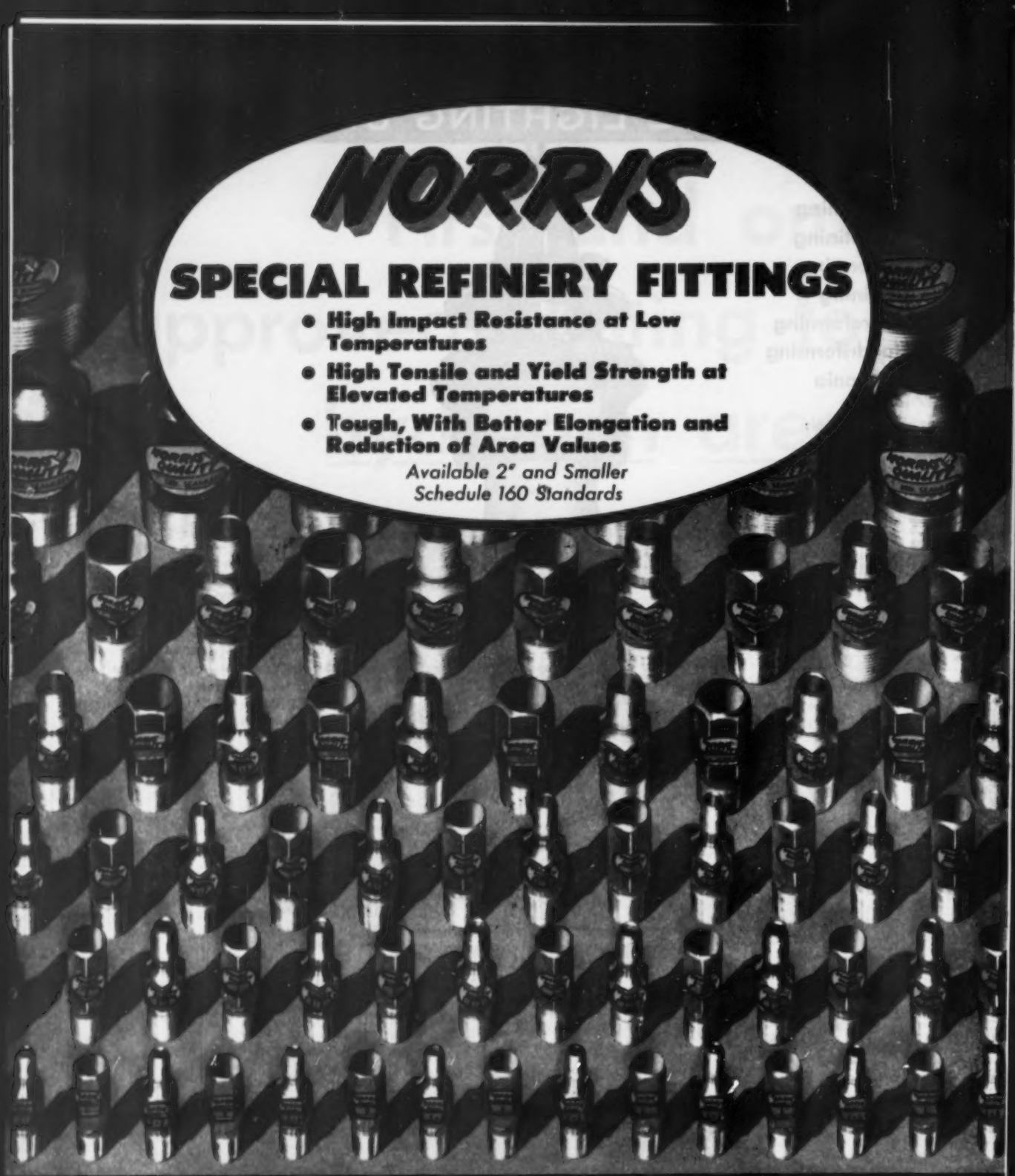
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Who's Building . . .

Socony-Vacuum Companies To Add 13 Cat Reformers

Thirteen catalytic reformers are scheduled to be built at refineries of Socony-Vacuum Oil Company and affiliated companies in the U. S. The units are part of a construction program which calls for capital expenditures of $165 million at the company's refineries in 1954, 1955 and 1956.

The new reformers will employ two processes developed by Socony-Vacuum —Thermofor Catalytic Reforming (TCR) and Sovaforming. The 13 units will be built at 11 of the 13 company refineries in the U. S. and will have a total capacity of more than 130,000 barrels a day.

One unit recently given final tests at the Torrance, Calif., refinery of General Petroleum Corporation, Socony-Vacuum's West Coast affiliate, employs the TCR process. A second TCR unit now under construction at the Beaumont, Texas, refinery of Magnolia Petroleum Company, Socony-Vacuum's affiliate in the Southwest, is scheduled for completion next month.

Two Sovaformers are now under construction; one at the company's Augusta, Kan., refinery and the other at the Ferndale, Wash., refinery of General Petroleum. The unit at Augusta is scheduled to be completed in October; the one at Ferndale near the end of 1954, along with other units of the new 35,000-barrels-a-day refinery under construction there.

Sovaformers are scheduled for construction in the immediate future at Socony-Vacuum's refineries at East Chicago, Ind., Paulsboro, N. J., and Trenton, Mich., to be followed in rapid succession by units at Buffalo and Brooklyn, N. Y., East St. Louis, Ill., and Casper, Wyo. Sovaformers also will be built at the Beaumont and Torrance refineries to supplement the TCR capacity.

Sinclair Chemicals Under Way on Petrochemical Unit

Sinclair Chemicals, Inc., a subsidiary of Sinclair Oil Corporation, has started construction of a petrochemicals producing plant at its Marcus Hook, Pa., refinery.

The plant will produce 18 million gallons a year of pure aromatic hydrocarbons including toluene, xylenes and paraxylene.

A license agreement has been negotiated with Universal Oil Products Company for a Udex unit to process 2300 barrels per day of selected catalytic gasoline fractions. Contract for construction of this unit, as well as an installation to produce 10 million pounds per year of paraxylene, a synthetic fiber raw material, has been awarded to Badger Manufacturing Company.

Feed stock for the entire petrochemical operation will be secured from Sinclair's new multimillion dollar catalytic reforming unit now being completed at the Marcus Hook refinery.

Continental Building Unusual Research Lab

One of the most unusual research laboratory buildings in the world is being completed by Continental Oil Company at Ponca City, Okla.

To cost approximately $500,000 the revolutionary structure is being built from an 80,000-barrel oil storage tank. When completed early in 1955, it will have a hole in the middle like a doughnut.

Primary purpose of the building will be to provide pilot plant facilities to explore the commercial feasibility of manufacturing petrochemicals already developed by the company's research laboratory staff.

The odd-shaped structure will be three stories high, with a well "like the hole in a doughnut" reaching upward through the center from ground level to roof. The three floors will provide 33,000 square feet of floor space.

Greeks Still Seeking Firm to Build Refinery

Interested firms have been asked by the Greek government to submit bids for erection of an oil refinery in Greece. The bids are to deal with installation and the execution of all related civil engineering work.

Bids are to be submitted to the Ministry of Co-ordination, General Directorate, by midday, September 20.

For some time the Greek government has been seeking a builder for its refinery. Earlier this year it rejected bids by Socony-Vacuum Oil Company, a group headed by Spyros Skouras and a joint bid by Anglo-Iranian Oil Company, Royal Dutch-Shell and Purfina.

The engineering firm which will be entrusted with the construction of the refinery will be required to assume a number of obligations. Among them: upon completion of the project, to put into operation and operate the refinery on behalf of the Greek government for a period not to exceed two years, provided that the government so requires.

Selected last month to give the Greek government guidance on project bids was George Armistead & Company.

Up Goes Nitrogen Products Output

Allied Chemical & Dye Corporation Omaha plant

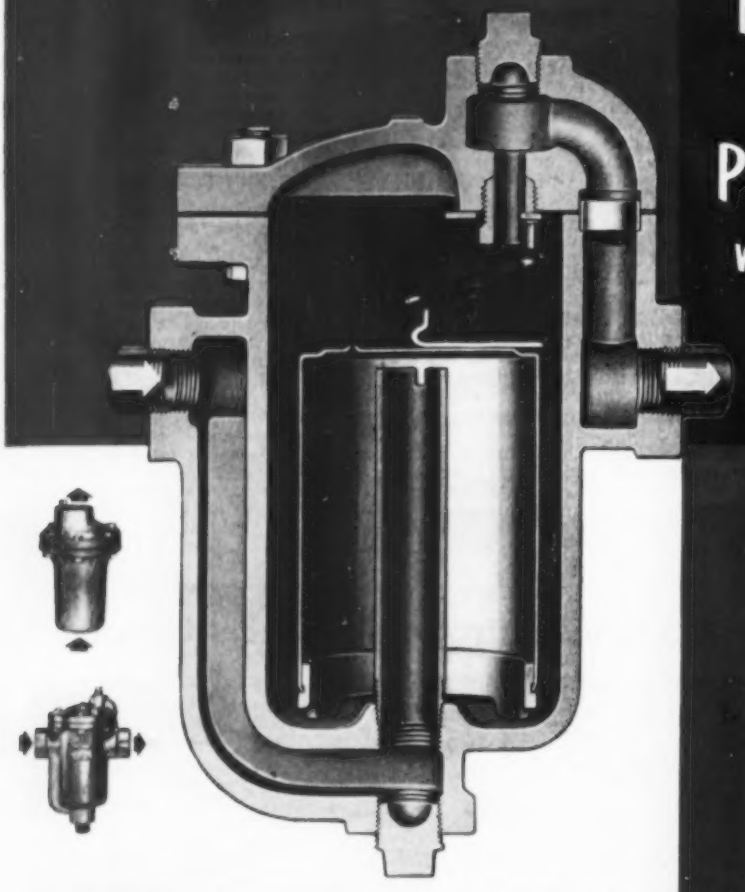
In staccato one-two-three order recently, the Nitrogen Division of Allied Chemical & Dye Corporation gave a big lift to the U. S. output of nitrogen products.

The chain reaction started a few months ago when the ammonia facilities at the division's new Omaha, Nebr., nitrogen plant were put into production. Plans at that time called for initial production of urea—made from ammonia and carbon dioxide—to start in July, which would have been the division's second contribution to U. S. output. But just before the urea facilities were started up, the company announced plans to double the original ammonia capacity of the plant, pushing startup of the urea facilities, which came off in July on schedule, into third place newswise in the company's expansion high jinks.

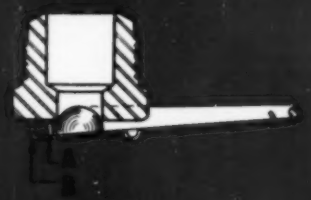
Completion of the first units of the plant, costing approximately $25 million, made possible an annual production of 61,000 tons of nitrogen in the form of ammonia and urea. Construction of the new facilities, which will double the ammonia capacity and also add production of various types of nitrogen fertilizer solutions, will begin as soon as the necessary supply of natural gas for raw material has been assured. Northern Natural Gas Company now supplies natural gas to the plant and has made necessary application to the Federal Power Commission to increase the supply.

Engineering and construction work on the facilities was done by Catalytic Construction Company of Philadelphia. The natural gas reforming facilities were installed by The Girdler Company of Louisville, Ky.

MORE TRAP CAPACITY PER DOLLAR with Armstrong two-phase leverage



HOW IT WORKS:



1. Valve in closed position.

2. As the bucket starts to sink, the lever fulcrums at "A", giving high leverage to open the valve against pressure. When valve is well open, the secondary fulcrum "B" touches the face of the valve seat.

3. Additional bucket travel results in fulcrum "B" becoming the pivot, permitting the valve to be opened wider so that restriction to flow of condensate is minimized.

Two-phase steam trap leverage is an original development by Armstrong and has been incorporated in Armstrong traps since the memory of most engineers runneth not to the contrary. It provides:

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2. Secondary lower leverage which permits the valve to travel well clear of the seat to minimize restriction to flow of condensate.

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ARMSTRONG STEAM TRAPS

Who's Building. . .

Washington engineering consultant. The Armistead firm, which has served in a similar capacity for numerous other projects, most of them for independents, will advise on the 30,000-barrel-a-day unit projected for construction.

Gulf Cleves Project Tops Small Tax Write-Off List

Largest rapid tax write-off certification of refining and related projects approved by the Office of Defense Mobilization last month was on the installation of a 10,000-barrel-a-day catalytic reforming unit and auxiliary facilities at Gulf Refining Company's Cleves refinery at Cincinnati, Ohio.

Estimated cost of the project is $4.6 million. Gulf was permitted to write-off for tax purposes over a five-year period 65 percent of $2.9 million for basic facilities and 45 percent of $1.6 million for auxiliary equipment.

Only a few other oil industry applications were approved by ODM last month. They were, with company, location, facility, total cost and amount certified:

Humble Oil & Refining Company—Baytown, Texas, facilities for increasing capacity of an alkylation unit, $473,000: $403,000 for specialized facilities and $70,000 for a control house, both at 100 percent.

Mid-West Refineries, Inc.—Alma, Mich., construction of a 2500-barrel-a-day hydrogenation (UOP Unifining process) unit and related facilities, $368,000: $300,000 at 65 percent, and $68,000 at 40 percent.

Standard Oil Company of California—El Segundo, Calif., additions and modifications to a crude oil distillation unit, $300,000 at 65 percent.

Panhandle Oil Corporation—Wichita, Falls Texas, installation of a gasoline stabilization system and LPG treating facilities and natural gasoline and LPG storage and loading facilities, $152,750: $76,780 at 65 percent, and $75,970 at 40 percent.

Du Pont Buys Land for Possible Plant Location

Options on land in California have been acquired by E. I. du Pont de Nemours & Company, Inc., towards the possibility of construction of a plant to manufacture tetraethyl lead and "Freon" refrigerants.

The design work now under way will incorporate Du Pont's most recent developments in the manufacture of these products.

Quaker State Puts First Of Three Units on Stream

First and largest of three UOP Platforming units contracted for by Quaker State Oil Refining Corporation has gone on stream at Farmer's Valley, Pa.

The 1500-barrel-a-day unit, designed for the production of motor fuel, is the first Platformer in the eastern part of the U. S. which is operating on full boiling range straight run gasoline. It is equipped with recycle gas scrubbing facilities for the removal of hydrogen sulfide.

Additional Platformers are being built

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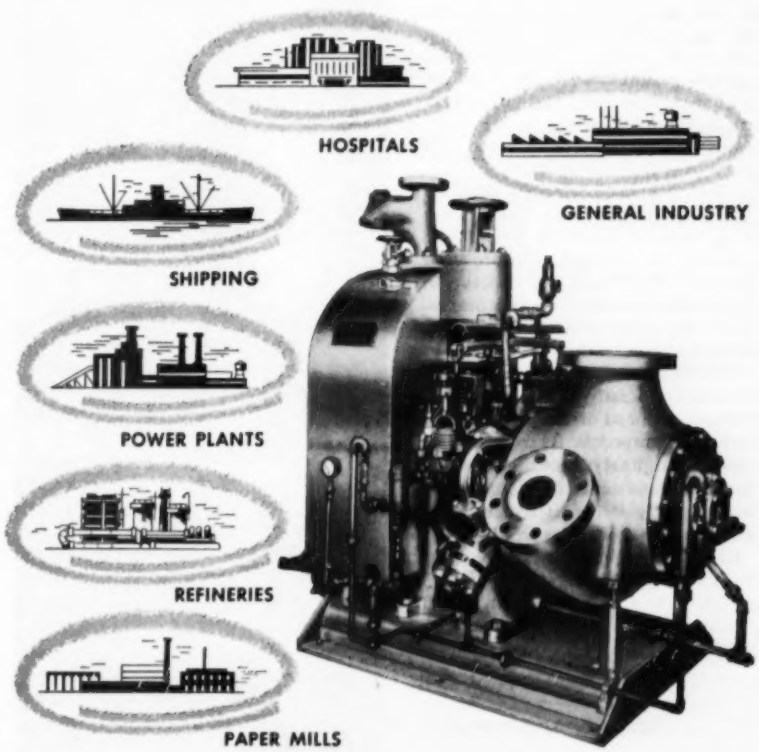

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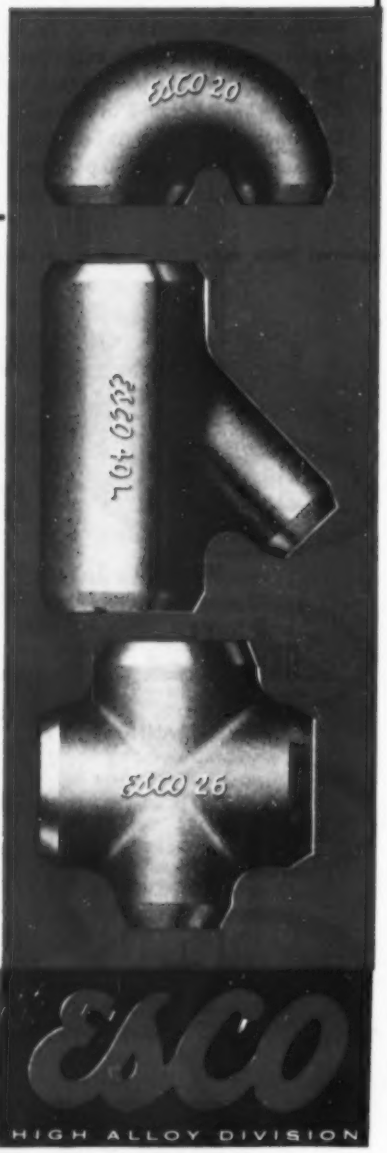

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Salt Lake City, Utah
Honolulu, Hawaii
In Canada, Vancouver, British Columbia and Toronto, Ontario

Who's Building...

for Quaker State at Emlenton, Pa., and St. Mary's, W. Va., and they are expected to go on stream this fall. All three were designed, engineered and licensed by Universal Oil Products Company. Procon, Inc., built the Platformer at Farmer's Valley and also is building the other two.

Sunset Looking Over Plan For Refinery in Oregon

Construction of a new refinery in Oregon is being considered by Sunset Oil Company, an independent producing, refining and marketing firm on the West Coast. This move by Sunset is but another indication of the gradual shift of refining activity to the Pacific Northwest which was predicted by PETROLEUM REFINER in April, 1953.

J. D. Sterling, president of Sunset, said that although plans still are in the talking stage, such a plant, if built, would have a capacity of 20,000 barrels a day. It would probably be located in Portland, where the company presently holds an option to buy on a piece of property.

Source of the crude, and whether it would come from foreign or domestic sources, was not revealed, but Sterling did state that a "major company" had offered to make the crude oil available if the plant were built. Although Sunset has most of its facilities in California, it does have 90 retail outlets in Oregon and 50 in Washington.

Sohio Plans Entry Into Petrochemical Production

The Standard Oil Company (Ohio) has announced that it will move into a new field of service and production with an investment of $17 million in a petrochemical manufacturing plant to be located in the Toledo-Lima, Ohio area.

Engineering plans are now substantially complete, but several plant sites are still being considered. Final selection, expected soon, will be based upon the results of nearly-completed appraisals of water and waste disposal problems and comparisons of delivered raw material costs.

The proposed plant will produce anhydrous ammonia, urea, nitrogen solutions and nitric acid. It will have a daily capacity of 300 tons of anhydrous ammonia, of which almost 200 tons per day will be used in additional processing to make approximately 125 tons of urea, 60 tons of nitric acid and over 200 tons of nitrogen solutions. Construction of the plant is expected to start this month, with completion scheduled for early in the fourth quarter of 1955. The M. W. Kellogg Company will construct the anhydrous ammonia plant.

Atlantic Girbotol Unit Being Built at Atreco

A Girbotol purification plant is currently being erected for The Atlantic Refining Company at Atreco, Texas. The plant will remove hydrogen sulfide from a catalytic reformer recycle hydrogen stream. It was scheduled to have been placed in operation last month.

All design, engineering and procure-

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

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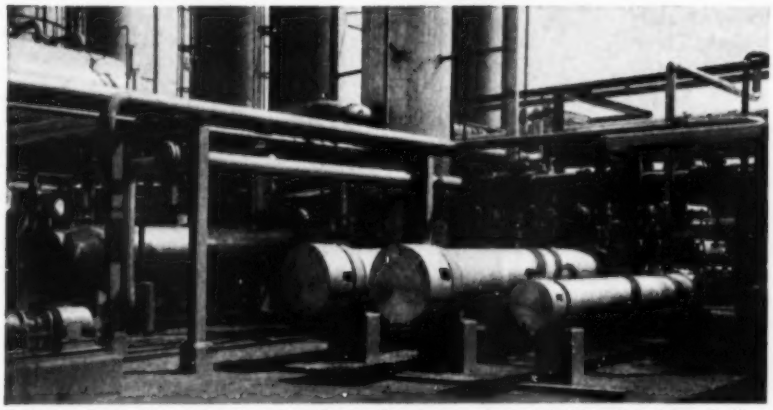
How to Benefit with Bridgeport Duplex Tubes



Bridgeport Duplex Tubes in condensers and heat exchangers mean longer tube life and greater production.

The list of new petroleum and chemical products grows by leaps and bounds every year. And a variety of new corrosion problems is always close behind. Many new and useful end products, derivatives and intermediate fluids require careful selection of condenser and heat-exchanger tube alloys, particularly those with specific corrosion-resistant properties to insure long tube life and greater efficiency. A wide increase in cooling water pollution and a trend toward greater utilization of salt and brackish waters have added heavily to the burden of tube performance. Corrosive attack from both product and cooling water on single-alloy tubes often results in premature failure from attack by one media or the other. Bridgeport Brass has solved many such double corrosion problems by drawing two specially selected alloys concentrically together into double-walled Duplex Tubes.

The use of Duplex Tubes in operations subject to different types of inside and outside corrosion offers many advantages.

Longer Service Life

The alloys selected for Duplex Tubes are each chosen for their specific capacity to handle one particular corrosive media. Admiralty Low Carbon Steel Duplex Tubes for a cooler handling benzol liquid and sea water are an example. In this case, Admiralty has excellent corrosion resistance to sea water while the low carbon steel carries benzol liquid well. A tight mechanical bond joins the two concentric tubes at a metal-to-metal interface. Each alloy is exposed to corrosion on only one surface, that facing the media it was selected to handle. Thus each alloy can perform to the full extent of its service capacity without exposure to attack from the second media. This fact spells longer service life and lower long-term tube cost.

Lower Maintenance Costs

When tubes are made of alloys specially chosen to handle specific corrosive fluids, it is possible to predict much more closely how long the tubes will perform before they require cleaning or replacement. It isn't necessary to shut down expensive continuous operations for premature repairs. Duplex Tubes, with alloys that match the media, will often reduce the frequency of tube replacement and cleaning maintenance costs.

Improved Products

Single-wall tubes are often made of a compromise alloy—one that will give the best possible resistance to corrosion from both inside and outside media. The result can be contamination of a highly refined or carefully balanced product. With Duplex Tubes no such compromise is necessary. The alloy facing the product and the alloy facing the cooling or heating media are both chosen on the basis of their compatibility to their respective fluids. An excellent example of the above is the use of Duplex Tubes made up of Stainless Steel/Copper, or Aluminum/Copper for equipment used to process food products, pharmaceuticals and fine chemicals.

Increased Production

Bridgeport Duplex Tubes, in some cases, have higher heat-transfer efficiency than tubes of a single metal. For example, Duplex Tubes made of copper and steel used in an ammonia condenser will give greater operating efficiencies than plain steel tubes, due to the absence of an insulating layer of rust and/or organic fouling from algae and slime on the copper cooling-water side.

Greater Safety

Condenser and heat-exchanger tubes are subject to mechanical stress in operation. The force of flowing fluids, operating pressures and temperatures, and the stress of thermal expansion put added burdens on tube walls. By using Duplex Tubes in such combinations as Admiralty/Steel, Aluminum/Copper, and Monel/Red Brass, the best qualities of strength and resilience, as well as heat conduction and corrosion resistance, are contributed by each metal.

Call on Bridgeport for Service

To find out how you can use Bridgeport Duplex Tubes to your advantage, call your local Bridgeport office. Bridgeport's Technical Service or Corrosion Laboratory is always ready to help you select the right Duplex combination for your service conditions. (2156)

Ask for a copy of Bridgeport's Duplex Tube Technical Bulletin. You'll find it a valuable guide to the selection and installation of Bridgeport Duplex Tubes.

For more data on advertised products, use Readers' Service Cards, last page.

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Who's Building. . .

ment services are being performed by The Girdler Company, Louisville, Ky.

Plans for Constructing Two Refineries Announced

Plans for the proposed construction of two refineries and three pipe lines linking oil fields in Wyoming, Texas, Colorado and New Mexico have been announced. Bert Clardy, a Dallas, Texas, public relations man, announced the proposals which call for a 10,000-barrel-a-day gasoline refinery at Albuquerque and a similar installation near Phoenix, Ariz.

Clardy is a spokesman for three firms reportedly interested in building the facilities. He said the project would cost about $72 million. Commitments already have been made to begin taking delivery of crude oil by January 1, 1956, estimated completion date of the facilities, Clardy said.

Cosden Starts Operation Of New Alkylation Unit

A new 2650-barrel-a-day alkylation unit has gone on stream at the Big Spring, Texas, refinery of Cosden Petroleum Corporation. The new unit is the first using Stratco horizontal contactors made by Stratford Engineering Company to go into operation.

The new $2 million UOP unit was built by Refinery Engineering Company, Tulsa. It produces rerun or light aviation alkylate using gas stream from thermal and cat cracking operations as feed.

Carbide and Carbon Says Torrance Plant Going Up

"Construction of the Torrance, Calif., plant of Carbide and Carbon Chemicals Company is proceeding as planned and good progress has been made," H. B. McClure, president, said last month in reply to rumors that "plans for the Torrance plant are believed to have been temporarily shelved."

At present, construction has been completed on all service buildings. All major equipment has been purchased and contracts for construction of foundations, underground piping and process buildings have been awarded to a group of contractors working in a joint venture.

The plant will initially produce 60 million pounds of polyethylene and substantial volumes of ethylene oxide, ethylene glycol and ethylene glycol antifreeze. To cost approximately $36 million, it is expected to be in full operation by the end of 1955.

Mississippi River Fuel Starts on Ammonia Plant

Construction has started on Mississippi River Fuel Corporation's $15 million ammonia plant at Crystal City, Mo., near St. Louis. To produce anhydrous ammonia, nitric acid and ammonium nitrate for distribution in the Midwest, the plant is expected to start operating in late 1955. Initially, it will have a

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Who's Building...

Construction Capsules

capacity of 140,000 tons a year. The Fluor Corporation, Ltd., has the prime contract for design and construction.

Mid-Continent Catformer On Stream at West Tulsa

The newly completed 7500-barrel-a-day catalytic reforming unit at Mid-Continent Petroleum Corporation's West Tulsa, Okla., refinery is a Catformer unit and not a Platformer unit as reported in the August PETROLEUM REFINER. The Catformer, built under license of The Atlantic Refining Company, is now on stream.

Esso Standard Oil Company, a subsidiary of Standard Oil Company (New Jersey) has completed acquisition of land outside Portsmouth, Va., for a planned multimillion dollar refinery site. Esso's land investment there now totals more than 900 acres representing approximately $725,000. When construction will begin on the refinery and how much it will cost has not been disclosed.

The Ohio Oil Company has put a new 8330-barrel-a-day Houdriformer on stream at its Robinson, Ill., refinery. The catalytic reforming unit, built by Catalytic Construction Company under the direction of Houdry Process Corporation, is designed primarily for production of high octane motor gasoline.

Sun Oil Company has concluded licensing arrangements with Houdry Process Corporation for a 27,000-barrel-a-day Houdriflow cat cracker to be constructed at Sun's Toledo, Ohio, refinery. Catalytic Construction Company is to build the unit, which is scheduled for completion early in 1955.

Martin Wunderlich Development Company expects to begin full operation of its new gasoline recovery plant in the East Vernon Pool of northern Kay County, Okla., near Blackwell, before the end of this month. Walco Construction & Engineering Company of Tulsa built the plant.

Crown Central Petroleum Corporation expects to complete construction of a 5500-barrel-a-day Houdriformer at its Houston refinery by next month. The unit, licensed by Houdry Process Corporation, is being built by Blaw-Knox Company.

Honolulu Oil Company in conjunction with Payne, Johnson & Byars, of Tyler, is moving towards completion of a gasoline recovery plant near White Flat Pool in Nolan County, Texas. The $1 million plant is scheduled for completion by December. Gasoline Plant Construction Company of Houston is the contractor.

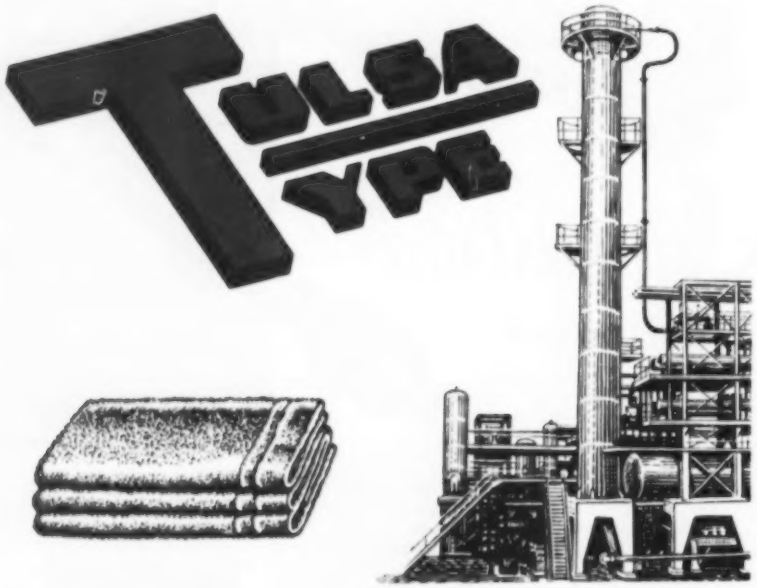
Salt Lake Chemical Company, Dallas, Texas, will start construction of an $8 million anhydrous ammonia plant at Dallas right away. The plant will have a capacity of 120 tons a day of ammonia and 30 tons a day of dry ice. It is expected to begin operations by December, 1955.

Salt Lake Refining Company, a subsidiary of Standard Oil Company of California, has started construction of a $2.5 million fluid cracking unit at its plant on the north side of Salt Lake City. The Fluor Corporation, Ltd. is building the new addition, which is to be completed in May, 1955.

Consumers' Co-operative Refiners, Ltd., officially opened its newly-modernized Regina, Sask., Canada, refinery last month. New units added in the modernization cost about $8 million and pushed capacity of the refinery to 11,000 barrels a day.

Richhold Chemicals expects to begin construction son of a phthalic plant near Montreal. The Canadian plant will cost an estimated $750,000 and will produce 4 million pounds a year.

British Dominion Oil Company is moving forward in its negotiations for construction of an $18 million fertilizer plant in southern Alberta. Exact location of the proposed plant, which will be used for processing ammonium nitrate, has not been selected. Northwest Nitro-Chemicals, a new company in which Frank McMahon, Calgary, and Ford, Bacon & Davis, Inc., New York engineering firm, are associated, will



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A well-known trademark — the signature of a product's maker — is as important on a giant steel bubble tower as it is on your best guest towels. And TULSA TYPE, for 30 years the trademark of FLINT STEEL refinery and natural gasoline plant equipment, has become one of the best known labels in the industry.

The TULSA TYPE name is your assurance of sound engineering and precision workmanship on every piece of equipment. All manufacturing processes used in the fabrication of TULSA TYPE equipment comply with API-ASME and ASME industry codes. Look for TULSA TYPE when you need steel plate fabrication for petroleum or petrochemical plants.

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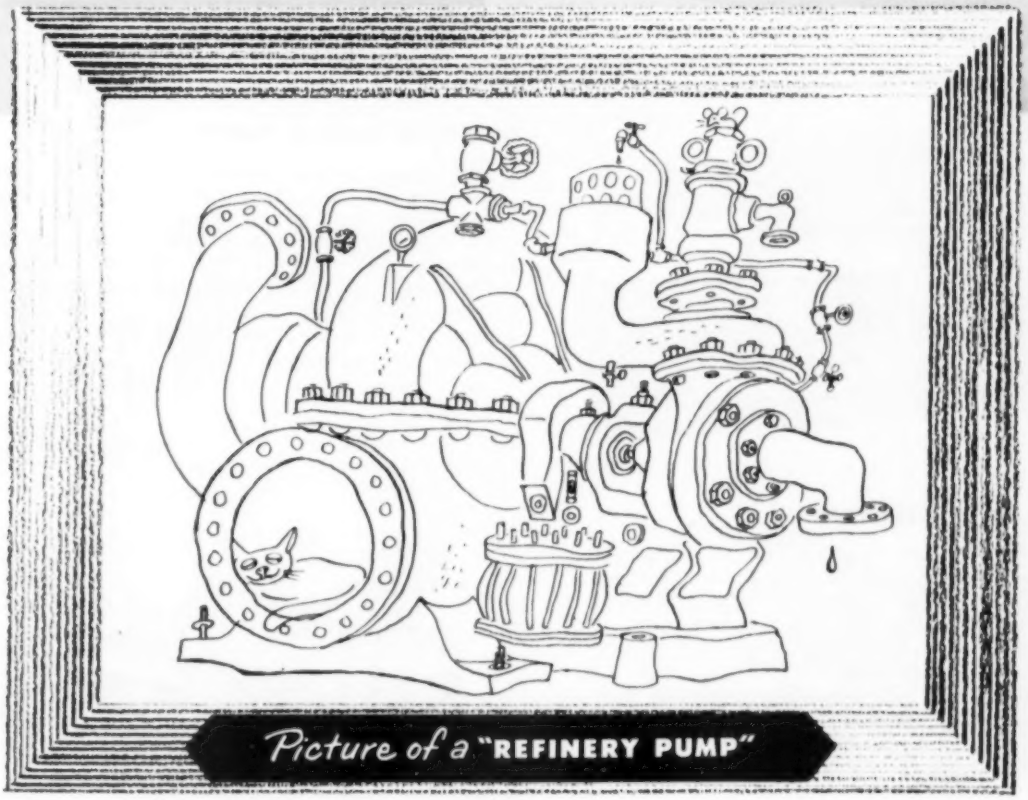
BJ

engineered answers to refinery pumping problems



Picture of a **"REFINERY PUMP"**

"Refinery Pump?" There ain't no such animal.
But if one pump could be all things to all processes, it *might*
look like this. Fact is, however, that in refining *it's pretty important*
to have each pump fitted to its specialized job.
No one answer is good for all.

That's why Byron Jackson builds *job-engineered pumps.*
With a BJ you're sure of a pump that sizes up to the need
and is pin-point engineered to profitable performance.

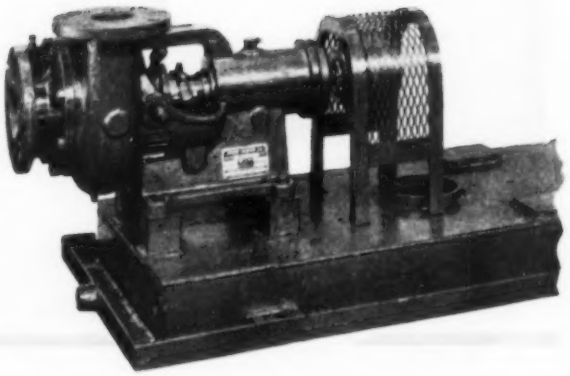
BYRON JACKSON PUMPS

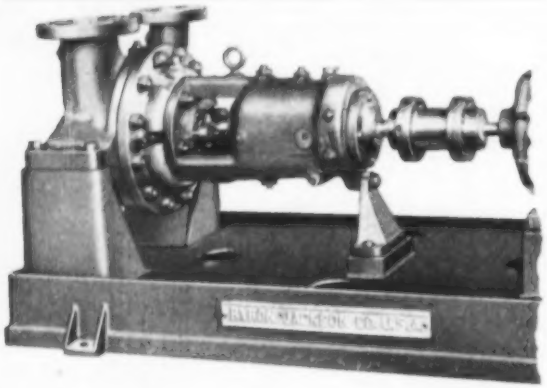
BYRON JACKSON PUMPS

BJ Job-Engineered

BJ FIGURE 1025-1125 PROCESS PUMPS

Moderately priced pumps for general-purpose process handling. Special emphasis is placed on the stuffingbox with three choices offered: (1) conventional packing, (2) water-jacketed stuffingbox, or (3) a BJ Mechanical Seal which replaces the packing. The Mechanical Seal is recommended where contamination of pumped liquid, leakage, frequent repacking or volatile liquid hazards are encountered. Capacities from 10 to 1000 gpm, heads to 600 ft. Temperature limit—300° F. Write for BJ Bulletin No. 353-300.



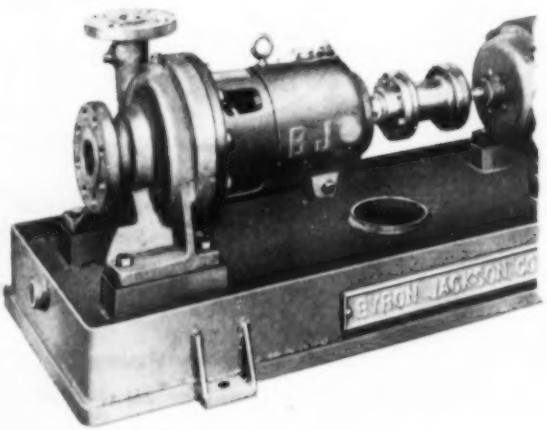


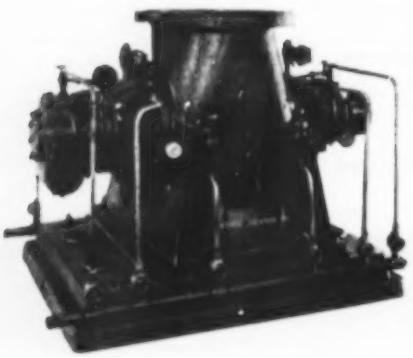
BJ TYPE FM PROCESS PUMPS

This general purpose process pump features a BJ Mechanical Seal as a functional part of the pump design. These pumps are built for continuous duty and can handle temperatures up to 300° F. Available in one standard construction to meet most process liquid requirements and cannot be ordered in special construction. Pump sizes: 2″ through 8″ suction, 1½″ through 6″ discharge. Capacities to 2800 gpm and heads to 700 feet. Write for BJ Bulletin No. 54-1-220.

BJ TYPE SM PROCESS PUMPS

A heavy duty process pump designed to handle fluids over a wide range of pressures and temperatures. Ideal for pumping hot or cold liquids near their boiling points. Maintains alignment at any temperature . . . is freely expansible at high temperatures . . . offers minimum NSPH requirements. Stuffingbox is built for severest service and pumps can be furnished in materials to suit operating conditions. Easily dismantled and reassembled. Capacities to 2200 gpm and heads to 1600 feet. Write for BJ Bulletin No. 54-1-230.





BJ DOUBLE SUCTION HOT OIL PUMP

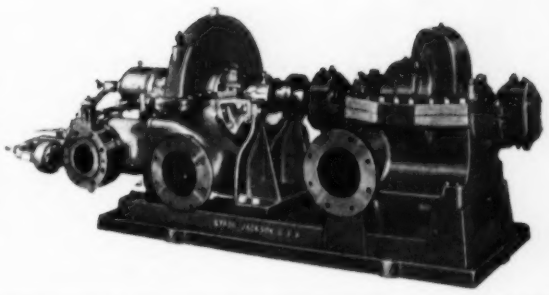
Developed for capacities beyond the range of single suction process pumps. This pump is designed to handle high temperature liquids on continuous service operation. Low entrance velocities and axial balance are obtained by use of a double suction impeller. Rotating element can be removed as a unit without disturbing the piping or driver. Capacity range from 1000 to 7000 gpm, heads from 100 to 700 feet. Construction materials to suit application.

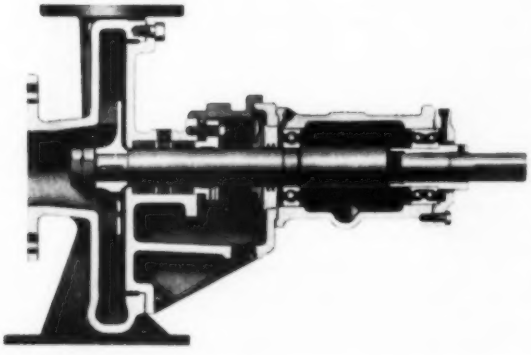
Refinery Pumps!

BYRON JACKSON PUMPS

BJ MULTIPLEX PUMPS

Models recommended for boiler feed and other heavy-duty pumping. For all classes of medium to high capacity, medium to high pressure and temperature service. Rugged construction features horizontally split case . . . easy inspection or cleaning without disturbing piping, bearings or driver. Opposed grouping of impellers equalizes end thrust. Staggered volute construction balances out radial forces. Pressures and temperatures as needed. Write for Bulletin No. 52-4000.





BJ CHEMICAL PUMP

This pump is engineered to the particular demands of chemical pumping. Designed for quick and easy dismantling without disturbing piping or driver. All parts except pump case and impeller are interchangeable. Corrosion-resistant catch basin protects base plate from corrosive leakage. Adjusting sleeve permits easy impeller adjustment without dismantling. Deflector and grease lubrication protects bearings from acid and fumes. Cored passages through impeller web keep stuffingbox under suction pressure. Four sizes: 1″, 1½″, 2″ and 3″ with capacities to 450 gpm, heads to 100 ft. Available in various materials to meet operating conditions. Write for BJ Bulletin No. 54-1-630.

BJ BILTON PUMP

A general purpose, close-coupled pump and motor unit. Ideal for all classes of medium and low head service . . . especially useful where space is limited. No rigid foundation or base is needed, and positive shaft alignment is always assured. Mounts in any position. Standard construction includes conventional stuffingbox or water-jacketed stuffingbox. Capacities to 2000 gpm, heads to 475 ft. Special construction provides BJ Mechanical Seal and explosion-proof motor. Write for Bulletin No. 353-1000.

BJ TYPE VMT PUMPS

Designed for pumping liquids—hot or cold—corrosive or non-corrosive—where the net positive suction head is limited and space is at a premium. Multi-stage pump is mounted in a barrel from which it takes suction. Standard models offer capacities to 2000 gpm, heads as required, and temperatures to 200° F. Special construction is available for higher capacities and temperatures. Write for BJ Bulletin No. 52-6600.

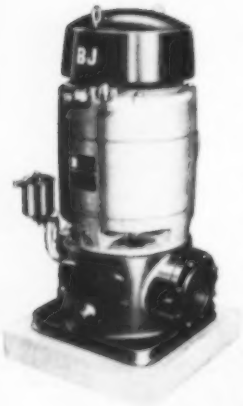
BJ HYDROPRESS PUMPS

Ideal for higher pressure, low capacity pumping requirements such as boiler feed service, hot or cold refinery service, and pipe line pumping. Vertical construction saves space, simplifies installation. Uniform non-pulsating flow . . . variable capacities without by-pass or speed changes . . . no relief valves required. Capacities from 10 to 300 gpm, heads from 200 to 7000 feet. Write for BJ Bulletin No. 52-6400.

BJ VERTICAL CIRCULATING PUMPS

These single or multi-stage vertical pumps are designed for continuous operation at high efficiencies in pumping medium to high capacities of water. Recommended for cooling tower, circulating, river intake, drainage and dewatering. Self-priming. Discharge can be above or below the ground line. Write for BJ Bulletin No. 52-6050.

BYRON JACKSON PUMPS



BJ DEEPWELL TURBINE PUMPS

BJ Deepwell Turbine Pumps can answer practically every primary water supply need. Three distinct types of bowl assembly and more than 100 individual impeller designs provide the one right pump for any requirement. As originators of the deepwell turbine pump, Byron Jackson's long experience assures the best in dependable pumping performance. Models for well diameters from 6 to 24 inches. Small "Bee Jay" model for wells 6" ID or larger. Capacities to 120 gpm. Also Bee Junior models for wells as small as 4" ID. Capacities to 50 gpm. Write for BJ Bulletin No. 54-2-100.

BJ SUBMERSIBLE PUMPS

For water pumping from a well, booster station or for standby service, the Submersible offers many installation and operating advantages. The pump and sealed motor unit operate completely submerged in the water . . . no pump house or structure is needed. No well is too deep . . . ideal for crooked wells or where flood menace exists. No problem of water contamination by dirt, oil or foreign matter. Capacities to 20,000 gpm and heads to 1500 ft. BJ Subette model for wells as small as 6" I.D. and larger. Write for BJ Bulletin 253-700 and 54-3-700.

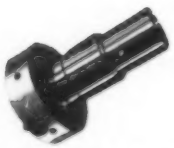
BJ SUMPMASTER PUMPS

A complete line of standard sump pumps in more than 3000 combinations. These vertical pumps are recommended for cooling and circulating and for booster service as well as for general sump service. Available in standard column lengths of 5, 10, 15 and 20 feet, with or without outer barrel. Self-priming. Capacities to 2600 gpm, heads to 300 feet. Write for BJ Bulletin No. 54-3-1420.

BJ PNEUMATIC SPONGE PUMPS

A compact, easily portable but amazingly rugged pump for dewatering sumps, tanks, ditches, shafts, bilges, etc., and for salvage work and other similar applications where the pumped fluid contains a heavy percentage of solids. The single stage pump has a non-clogging type impeller and is driven by a rotary air motor with variable speed control. Capacities to 125 gpm and heads to 76 feet. Write for BJ Bulletin No. 52-7035.

BJ MECHANICAL SEAL



Replaces the standard packing in the stuffingbox and eliminates the cost and trouble of repacking. Recommended where leakage, frequent repacking, volatile liquid hazards, or contamination of pumped liquids are encountered. Lower cost pumping performance is assured due to the completely reliable stuffingbox operation. Types to fit almost all centrifugal pumps. Available in material and construction combinations to answer various pressure, temperature and liquid handling requirements. Write for BJ Bulletin No. 54-1-10,000.

Byron Jackson Co.
Since 1872

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Who's Building . . .

operate the new plant.

Diadema Argentina, S. A. de Petroleo has completed construction of a new lubricating oil plant at Buenos Aires. The new facilities have a capacity to produce 600 barrels a day. The company is part of the Royal Dutch-Shell group.

British Petroleum Chemicals, Ltd., has decided to go ahead with the erection of a new chemical plant at its works at Grangemouth, Scotland. The plant will produce alkylate. Part of the raw material for the plant will be drawn from the adjacent refinery of Grangemouth Petroleum Refinery, Ltd. The new plant is expected to come into production during the latter half of 1955. British Petroleum is jointly owned by Anglo-Iranian Oil Company and Distillers Company, Ltd.

Shell Refining & Marketing Company, Ltd., has started construction of the first plant in Britain built for the production of isopentane, an aviation gasoline component. The unit is being built at the company's Stanlow refinery in Cheshire and is scheduled for completion in early 1955.

I.L.S.E.A.-Raffineria Oli Minerali expects to complete a new 500-barrel-a-day catforming unit at its Valmadrera (Como), Italy, refinery soon. The unit, licensed by The Atlantic Refining Company, is being built and was engineered by Tecnider.

Industrie Chimiche Italiane del Petrolio (I.C.I.P.) has dedicated and is now operating its new refinery at Mantua, Italy. The refinery has a crude oil processing capacity of 12,800 barrels a day.

Iraq's Government Oil Refineries Administration plans to request bids soon on construction of a lubricating oil plant to produce a full range of low and high grade oils for local consumption. To have a capacity of about 480 barrels a day, the plant will cost approximately $8.4 million. Iraqi engineers are reportly drawing up specifications and tender documents on their own.

Brea Starts Work on Ammonium Phosphate Unit

Construction has started on a new ammonium phosphate plant at Brea, Calif., for Brea Chemicals, Inc., subsidiary of Union Oil Company of California.

The ammonium phosphate plant at Brea will be constructed by Macco Corporation and is scheduled for completion the latter part of this month. The company expects to have two similar plants in operation at Brawley and Fresno, Calif., early next year.

CFCA Officially Starts Ammonium Nitrate Plant

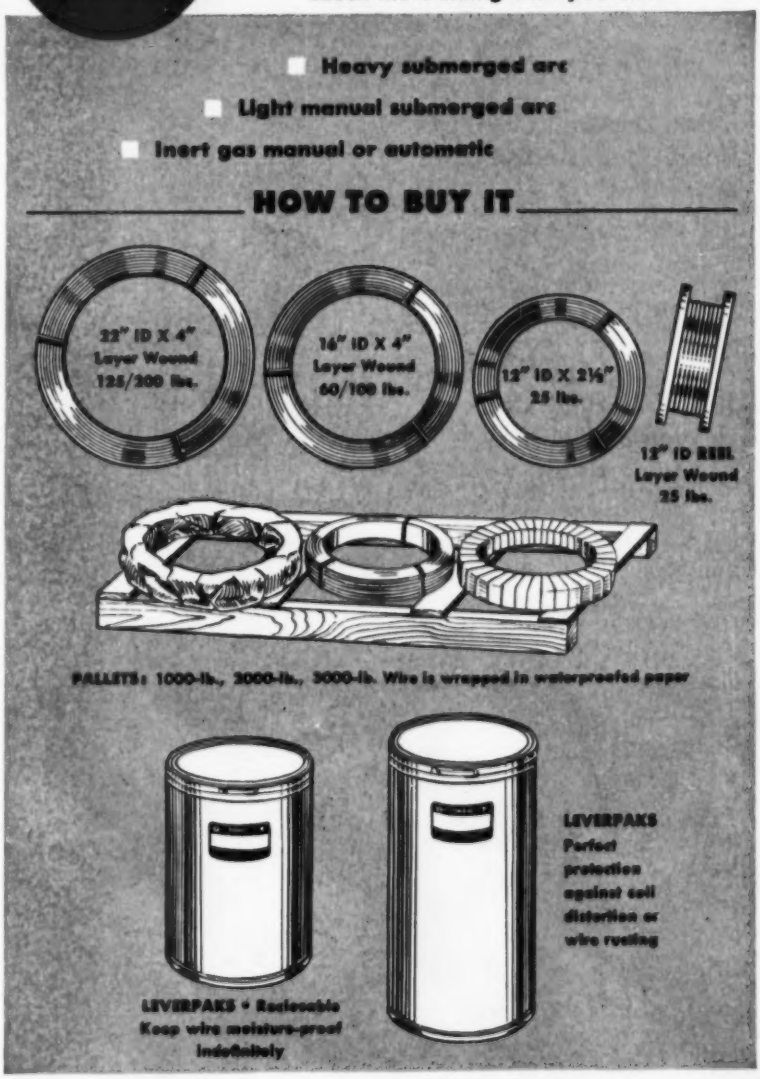
A new large-scale ammonium nitrate plant near Lawrence, Kansas, was dedicated late last month. It is owned by Cooperative Farm Chemicals Associa-

ACCO

Page Welding Wire

PAGE CHECK-OFF

Check the welding wire you use: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Light manual submerged arc
Inert gas manual or automatic
HOW TO BUY IT
22" ID X 4" Layer Wound 125/200 lbs.
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For more data on advertised products, use Readers' Service Cards, last page.

tion (CFCA), an affiliate of Consumers Cooperative Association, and is part of a project which cost approximately $15 million.

The 330-ton-a-day plant, designed and constructed by The Girdler Company, will convert ammonia to ammonium nitrate prills and nitrogen solutions, it was explained.

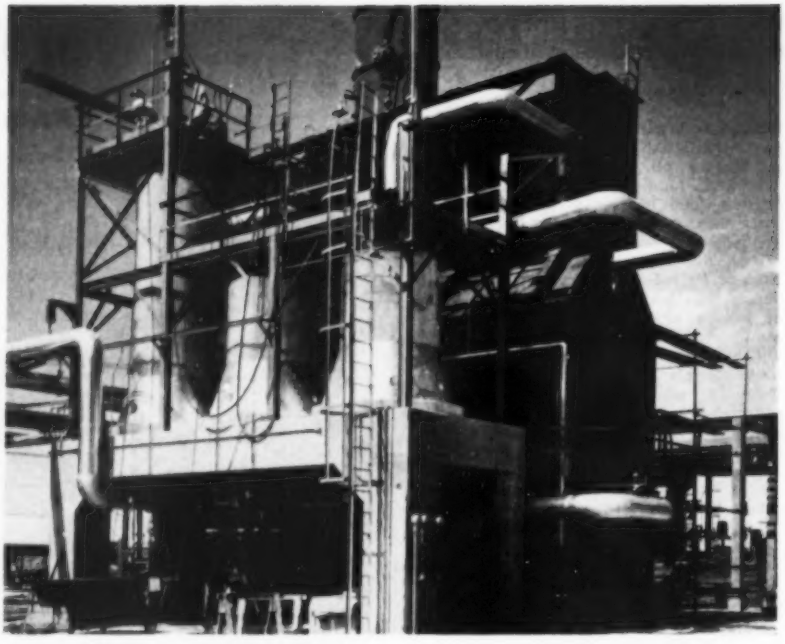
Moeller Company Expects Refinery Completion Soon

Construction of a refinery at Copenhagen, Denmark, is expected by the end of this year. Owned by A. P. Moeller Company, a steamship firm, the plant will have a capacity of 3000 barrels a day and is designed to produce residual fuel ship's bunkers and cracked gas for use in Copenhagen. Reportedly, plans are being considered to enlarge the installation into a complete refinery.

SAROM Adding Units To Ravenna Refinery

Construction has started at the Ravenna, Italy, refinery of Soc. Az. Raffinazione Oli Minerali (SAROM) on a second topping unit and a new visbreaker.

The topping unit will have a capacity of 15,000 barrels a day when completed at the end of this year. The visbreaker will have a capacity of 5000 barrels a day and is expected to be completed by March, 1955. Technider did the engineering design on both units.



New Sunray Platformer On Stream—

A substantial increase in the quality of both regular and premium grades of gasolines has been brought about at the Sunray Village (Duncan), Okla., refinery of Sunray Oil Corporation by this new 5000-barrel-a-day UOP platforming unit. Part of the company's 25,000-barrel-a-day catalytic cracking refinery, the unit was built by The Refinery Engineering Company, of Tulsa.

Standard-Vacuum Will Add Alkylation Unit at Altona

A $3,825,000 alkylation plant will be included in the expansion program now under way at the Altona, Victoria, Australia, refinery of Standard-Vacuum Oil Company, the company has announced. The unit, expected to go on stream in two years, will enable Standard-Vacuum to make some 1500 barrels a day of aviation gasoline, about half of Australia's civil and military requirements. The expansion program is designed to bring the refinery to a capacity of 27,000 barrels a day.

Conoco Starts Work on Colorado Gasoline Plant

Construction has started on a $2 million natural gasoline plant and gas gathering system for Continental Oil Company, 30 miles south of Brush, Colo.

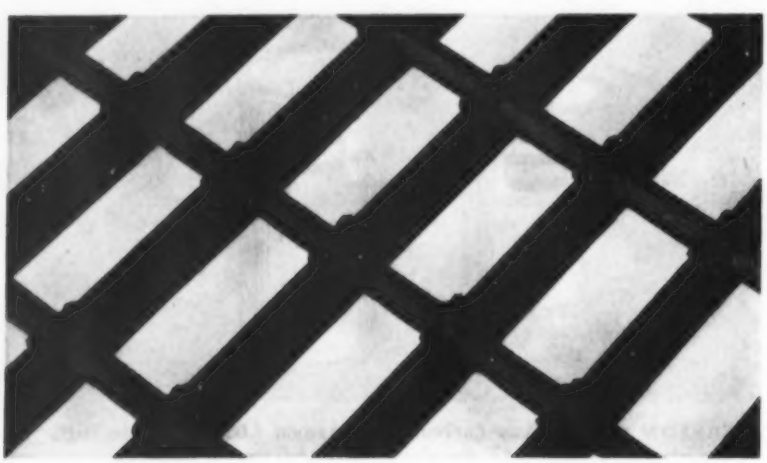
To be in operation about November 1, the plant will have a capacity to process 10 Mmcf of gas daily. It will produce natural gasoline, propane and butane for industrial and consumer use.

In addition to Conoco, which will operate the facilities, owners of the plant include several other interests.

Rock Island Refining Puts Platformer on Stream

A new UOP platforming unit, the first of its type to be entirely controlled by electronic instruments, went on stream recently at the refinery of Rock Island Refining Corporation northwest of Indianapolis, Ind.

The 2400-barrel-a-day unit is designed for the production of motor fuel.



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Corrosioneering News

Quick facts about the services and equipment Pfaudler offers to help you reduce corrosion and processing cost.

Published by The Pfaudler Co., Rochester, N.Y.

Pfaudler Acid-alkali-resistant Glass Now Standard on Glassed Steel Units for Severe Chemical Service

On September 1, 1954, acid-alkali-resistant glass became standard for all Pfaudler glassed steel equipment for severe chemical service. This new glass was first introduced to the chemical industries in November, 1951, and has been available as "special" since then.

Exceptional Corrosion Resistance

Wide and varied field experience over the past three years fully verified the original expectations for this glass—it has acid resistance equal to or better than the previous standard glass and, in addition, it is *three times as resistant* to alkaline solutions.

Specifically, this glass is resistant to corrosion by all acids (except hydrofluoric), even at elevated temperatures and pressures, and to alkaline solutions up to pH 12 and 212°F.

10% Price Reduction

As "special," acid-alkali-resistant glass carried a 10% premium charge over the former standard glass. Now as a standard, this premium is eliminated and it will be available at no increase in price.

Identification

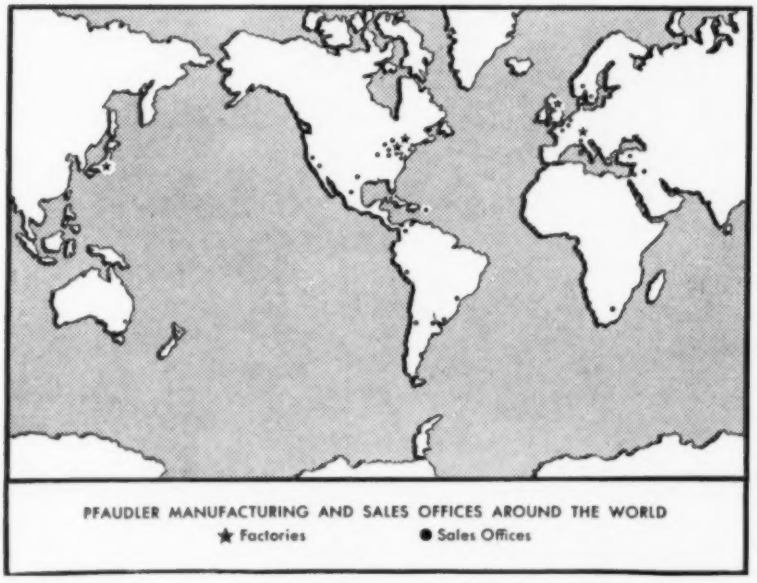
Acid-alkali-resistant glass, like the former standard, is deep blue in color. For easy identification, there is a glass number on the name plate of every Pfaudler vessel. At present, the number "53" is used to designate the new standard glass; "42" designates former standard. A new numbering system is now in process. Details later in "Corrosioneering News."

Both of these glassed steel discs were exposed to buffered caustic soda (pH 11.5) at 212°F. for 30 days. Acid-alkali-resistant glass (left) was unaffected.

Note how the high-quality glass which was formerly used in Pfaudler glassed steel vessels was severely etched.

Field Experience "proves in" acid-alkali-resistant glass

A 1000-gallon oxidation kettle, lined with acid-alkali-resistant glass, was placed in use 3½ years ago, processing sodium hypochlorite bleach containing 12-15% free chlorine. It produced 3,694 batches before showing noticeable wear. This is more than three times as many batches as were possible with regular high-grade Pfaudler glass.



PFAUDLER MANUFACTURING AND SALES OFFICES AROUND THE WORLD

★ Factories ● Sales Offices

New Forces Join Pfaudler's War on Corrosion

It's a long swim from Rochester, N. Y. to Kobe, Japan, but chemical, pharmaceutical and other industries in Japan have been clamoring for the type of equipment Pfaudler makes.

So Pfaudler has joined forces with the Kobe Steel Works, forming the Shinko-Pfaudler Company, Ltd. This company now offers glassed steel and alloy processing equipment in Japan and parts of Southeast Asia.

Pfaudler finds its equipment now being bought with many different currencies—yen, pounds, Deutsch marks, dollars, pesos—to mention a few—with factories in Scotland, Germany, Japan and the U. S.

These overseas facilities are of special importance to American companies with plants abroad. With Pfaudler equipment available, you can duplicate your processes, relying on the same corrosion resistance that you get from Pfaudler vessels produced domestically.

SOLVENT RECOVERY—big dividends for small investments

Many production men have discovered a gold mine right at their own back door, in the form of recoverable solvents. By installing a Pfaudler solvent recovery system they have greatly reduced processing costs. The equipment quickly pays for itself.

Of course, your solvent recovery problem may be unique in itself, requiring the services of Pfaudler process engineers to work out an economical solution.

Recovery Systems Pay Off

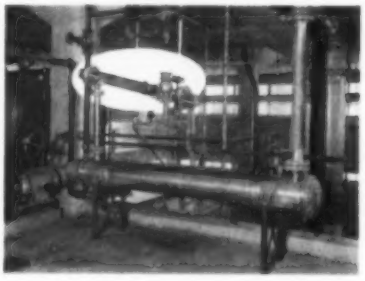
Two typical examples of solvent recovery systems worked out successfully in this manner are those at Armour Laboratories and Cudahy Packing Co.

At Armour, the problem was to recover alcohol used in making biologicals, and to prevent contamination of the recovered alcohol. The solution: Pfaudler designed, built and installed an all-stainless system with a 53-ft. distillation tower, that is providing exactly the quality and quantity of recovered alcohol required by Armour's specifications.

The Cudahy problem had a few different wrinkles. To recover a highly volatile, expensive solvent, it was necessary for Pfaudler process engineers to develop a two-stage system. This included a large, stainless steel heat exchanger to recover most of the solvent, and a small, refrigerated unit to condense escaping vapors.

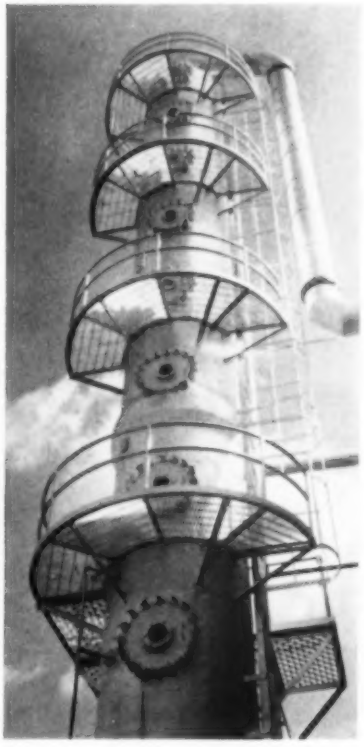
Fast Delivery

Delivery on these systems is amazingly fast—sometimes as quickly as 4 weeks, because of Pfaudler's policy of using "flexible standard" units wherever possible. These are economical standard designs which incorporate the most often needed "custom" features. If necessary, they become the "building blocks" for further custom fabrication.



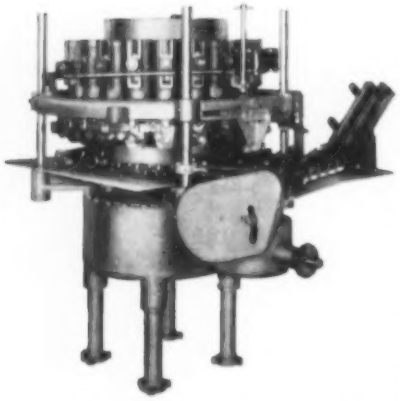
Unique two-stage system at Cudahy Packing Co. uses "flexible standard" heat exchanger and a second condenser (circle) for vapors escaping through vent.

Better check on *your* solvent recovery program. It will pay you to talk it over with Pfaudler. Drop us a line and we'll be glad to answer your questions.



This 53-ft. distillation tower is part of the Pfaudler-engineered alcohol recovery system at Armour Laboratories.

Split-second packaging saves dollars in many industries



One of 5 models, this Pfaudler RP-21 piston filler provides high-speed, accurate filling and easy cleaning.

Spinning out as many as 14 filled cans every second, Pfaudler filling machines are helping to fill you, your baby, your dog . . . and even your auto's crankcase!

Orange juice, baby food, dog food and motor oil are but a few of many products that come off these remarkable machines at work in a variety of industries across the country.

If you have a product to be packaged, perhaps you can benefit from Pfaudler split-second filling – accurate to ± 1/10 of an ounce. Easy to operate and to clean, these machines skyrocket production but keep maintenance costs at ground level.

Pfaudler makes two types: rotary piston fillers for semiliquid products like heavy oil; and Pfaudler "King" gravity flow fillers for liquids. For further details, write for Bulletins 911 and 843.

These products are now being packaged on Pfaudler high-speed filling machines, at rates as high as 1/5 second per can!

TECHNICAL TALKS

A BAFFLING DISCOVERY

This agitation system uses its fingers to give you top speed and thorough mixing

You can pour oil and water into a Pfaudler glassed steel reactor, and get a 100% emulsion in minutes. Twenty years ago, it would have taken hours or you couldn't have done it at all.

The forward steps we have taken in agitation have led to a number of questions in the minds of chemical manufacturers. Questions like, "What position is best for the baffle?", "What kind of an impeller does the best job?"

We first heard such questions back around 1932. That year, a chemical manufacturer asked if we could stop "dragging our anchor," and start giving him the violent agitation he needed for his gas absorption problem. The anchor agitators we had been using just couldn't do the job.

Advent of Impeller

So we started toying around with extra blades on the anchor agitator. This rig was supposed to run at 90 RPM, and the engineers' slide rules said there was no reason why it wouldn't.

We tried it out. The shaft whipped and vibrated, and we didn't get the turbulent agitation we wanted.

That's when we developed impellers, and went seriously into the studies that produced Pfaudler agitation as it is known today.

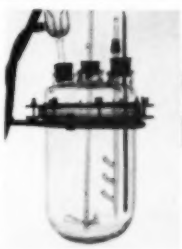
We replaced the anchor with a three-bladed impeller. This gave us a greater shear, and provided the violent agitation desired. But all the liquid in the vessel began to move as a body, and ended up with a swirling effect, very little mixing.

We broke up this merry-go-round with baffles, and—Eureka!—there was the answer. Good turbulence, activity throughout the vessel, and plenty of intermolecular contact! Our chemical customer was satisfied, and we had added immeasurably to the industry's knowledge of agitation.

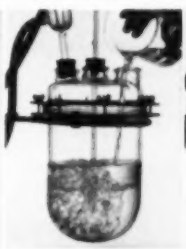
Like a Pump

This is basically what Pfaudler agitation consists of: a simple three-blade impeller operating close to the bottom of the vessel, so that the bottom head acts as half the impeller casing of a pump, producing a complete general agitation of almost any character. Baffles provide turbulence throughout the vessel.

If you've a problem in blending, suspension, emulsion, or other agitation, you can easily profit from our experience. A note on your letterhead will bring a packet of helpful data from us.

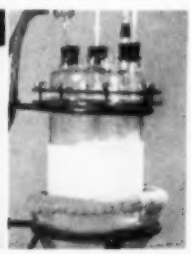


Laboratory equipment set up to show how a synthetic latex is made. The equipment is made to the exact scale of Pfaudler glassed steel plant production polymerizers.



First step in making a latex is the addition of a monomer, which later hardens to form the solid part of the latex. Note thoroughness of mixing action.

Next step is the addition of an emulsifier, or soap to effect mixing of oil and water. This material is similar to the detergents commonly used for dishwashing.



The agitator breaks monomer into tiny droplets. Heat causes the droplets to polymerize, while in suspension. Polymerized particles stay in suspension for long periods.

DOW'S VEST-POCKET LATEX FACTORY

Special laboratory equipment is exact scale-down of Pfaudler equipment used in actual production

Dow Chemical Company faced the problem of scale-up from laboratory synthesis of latex to a full-size producing plant.

The mountain came halfway to Mahomet, when the engineers chose Pfaudler glassed steel vessels which had the same properties of corrosion resistance and adhesion resistance as laboratory glassware.

And Mahomet came halfway, too. To duplicate Pfaudler agitation, Dow made glassware models of the Pfaudler vessels for laboratory use. These were exact scale-downs—right to impeller shape and the fingers on baffles.

Thus, Dow was positive that the success they had in the laboratory would be duplicated in full scale when they went into production.

How glassed steel assembly provides multiple use of a single nozzle

The fewer nozzles you have on a reactor or other vessel the better, particularly when you're operating under pressure or vacuum.

Here is a recently developed Pfaudler assembly which gives you multiple use of a single nozzle, eliminating the cost of adding extra nozzles for sight glasses, or for the introduction of several liquids.

This assembly is a combination of 2" return bends, and can be attached directly to a 2" flanged opening. All liquids drain freely and rapidly, with no pockets to impede the flow.

There are two observation glasses, each 3" in diameter, and porcelain funnels are also available to concentrate and direct liquid flow. We'd be glad to quote price or tell you anything more you want to know about this nozzle.

You can introduce up to *four* separate liquids by means of this single glass-lined arrangement, which has a sight box to help you observe the flow.

HEAT EXCHANGERS

Wise choice of design will give you better results at a lower price

There was a time when you could get by with the same type of exchanger for practically every process, but today's higher temperatures, higher pressures, corrosive chemicals and continuous processes have changed all that.

Careful engineering is needed to equip you with exactly the right type of heat exchanger for efficient heat transfer and durable equipment.

To give you these advantages, Pfaudler corrosioneers can draw upon a wide variety of designs and materials.

Old Stand-by

For many years, the basic heat exchanger recognized by the Tubular Exchanger Manufacturers' Association (TEMA) was the Class "R" unit, an internal floating head design, primarily for refinery use. It has two major disadvantages to chemical processors. First, the heavy hub flange construction is not economical when high-priced alloys are the materials of construction. Second, internal leakage could occur between the shell and tube sides at the floating head joint without your seeing it from the outside.

More desirable to chemical applications are the Class "C" and Class "A" exchangers. Class "C" is for carbon steel and nonferrous units, and Class "A" covers the high alloy units. Except for this distinction, these exchangers are almost identical in design.

Lower Costs

You save money with either of these two types, because they have Vanstone flanges for economical alloy construction. And to eliminate the old problem of internal leakage, you can use a packed floating head or fixed tube sheet instead of the internal floating head of the Type "R" unit.

In cases where you cannot use stuffing boxes, there are two solutions: Either use a Class "C" or "A" chemical type internal floating head or fixed tube sheet unit or, if straight tubes are not essential, use the Pfaudler U-bundle type unit.

Advantages of Fixed Tube Sheet

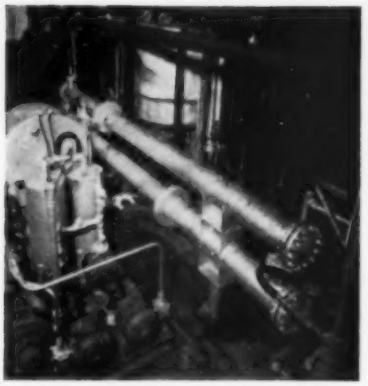
If you do not want to remove the tube bundle for cleaning, Pfaudler's fixed tube sheet unit will give you good service. It's designed for use where temperature differences on shell and tube sides are small, and within that limitation it provides wide versatility. It's easy to clean the tubes, simple in design; this exchanger is the money-saving workhorse of many a chemical plant.

Atomic Exchangers

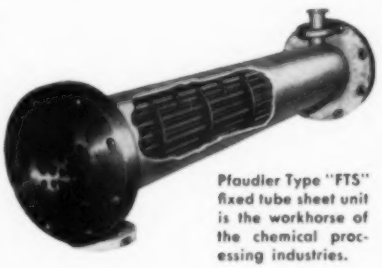
If you were to visit us at Pfaudler, you'd hear some pretty exciting things in our engineering department. Now they're talking about the new problems that have sprung up in the field of nuclear energy. What materials and designs do you use when you're handling transfer of atomic-fission heat? As an example, with the use of liquid metals, you have a fluid which because of its high thermal conductivity transfers most of its heat by pure conduction even though it is in turbulent flow.

This sort of thing simply means we set aside the old books and start writing some new ones.

But that's *our* problem. Right now, we're just as interested in solving *your* heat exchanger problem. For this, the books are written, the materials are at hand, and all we need is the nod from you . . . a letter outlining your needs will do the trick.



TO KEEP COSTS LOW you should emphasize length rather than diameter of heat exchanger, as shown in this actual installation.



Pfaudler Type "FTS" fixed tube sheet unit is the workhorse of the chemical processing industries.

Pfaudler
Corrosioneering News

Published by The Pfaudler Co., Rochester, N. Y.

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(Continued from Page 97)

times 1.33, the bond area required is 1.8 square inch per foot of slab, or #7 bars @ 18 inches, against #7 bars @ 10 inches required for moment. This represents a saving of nothing over the 1947 code.

Walter Hess,
Structural Engineer,
Sinclair Refining Company

Further Reply:

Most of Mr. Hess' comments are simply a matter of opinion and standard practice.

His question concerning the saving of steel that can be effected is explained as follows:

Some designers extend planes at 45° from the corners of the pedestal, forming a trapezoid, the moment of which has to be resisted by the steel across the pedestal. It was this method to which I referred, and for an 18 foot oct. approximately 50 percent of the steel can be saved by calculating the moment according to the current ACI code.

Emmett G. Jackson,
Civil Engineer

Argentine Query

To The Editor:

In E. G. Jackson's article "Foundations for Self-Supporting Towers," to my understanding, the section modulus is not correctly interpreted with respect to the calculations for anchor bolts.

The section modulus used in strength of materials is expressed as the relation between the moment of inertia of the section and the distance of the farthest fibre, and its unit is the cubic centimeter, the cubic inch or the cubic foot.

In members submitted to a simple flexion, the flector moment in a given section divided by the section modulus of that section, gives the maximum stress at that point. If the case is that of a composed flexion, that is to say, a simple flexion and an axial load, the maximum stress is obtained by adding algebraically the stresses produced by the axial load and the corresponding flector moment.

In the above mentioned article I gather that the expression given for the section modulus, is nothing but a fictitious distance which represents the central nucleus or kern.

On the other hand, in solving the above problem I sustain that the area of the foot plate should be taken into consideration. In self-supporting towers, we have stability when the resultant of the actuating forces come within the central nucleus of the section. This section is no other than that formed by the supporting base ring of the tower.

The actuating forces are: the weight of the tower, the wind and the stresses on the anchor bolts.

Where:

P = Weight of the tower
M = Wind moment at the base ring
a_b = Net area of one bolt
N = Total numbers of bolts
S_b = Allowable stress of bolts
d_e = Outside diameter of the base ring
d_i = Inside diameter of the base ring

$$\frac{\pi}{4}(d_e^2 - d_i^2) = \frac{\pi d_e^2}{4}(1 - n^2) =$$

area of base ring

$$n = \frac{d_i}{d_e}$$

$$\frac{\pi d_e^3}{32}(1 - n^4) = \text{section modulus of base ring.}$$

The total weight of the tower exerts a pressure on the base ring and is given by:

$$\frac{P}{\frac{\pi d_e^2}{4}(1 - n^2)}$$

The wind exerts a pressure to leeward and a traction to windward, on the base ring. These are:

$$\frac{M}{\frac{\pi d_e^3}{32}(1 - n^4)}$$

So the difference between them is the traction exerted on the anchor bolts, or in other words, that shall be the stresses on the bolts in order that the results of the actuating forces shall come within the central nucleus.

$$\frac{M}{\frac{\pi d_e^3}{32}(1 - n^4)} - \frac{P}{\frac{\pi d_e^2}{4}(1 - n^2)} = \frac{N S_b a_b}{\frac{\pi d_e^2}{4}(1 - n^2)}$$

Simplified, we obtain the net area of one bolt

$$a_b = \frac{M}{\frac{d_e}{8}(1 + n^2) \cdot N S_b} - \frac{P}{N S_b} \qquad (1)$$

Where $\frac{d_e}{8}(1 + n^2)$ = semiaxis of the central nucleus of a circular crown.

The (1) is similar with that given by Mr. Jackson, but here we take in account the shape of the base.

Ing. Américo Chiaravalli,
Calle 8 No. 1340,
Ciudad Eva Perón,
República Argentina.

Engineering Picture

To The Editor:

I had the pleasure of addressing 13 young men and a young woman at a "Career Clinic" in our church on July 13.

We were to discuss "Engineering" and what future these young people could look for in such a profession.

Your June, 1954 edition of PETROLEUM REFINER has many useful and interesting articles and I recommended they get a copy and learn for themselves, first hand.

However, the recommendation was reversed and now I am asking you to send me six copies of the June, 1954 edition of PETROLEUM REFINER and bill me for same.

If only one person in that group found for himself or herself the profession he or she wants to enter, then my time spent preparing for and presenting the "Picture of Engineering" was well used.

Such issues as the June, 1954 edition of PETROLEUM REFINER should make you very proud as publishers of useful and helpful information to those in the profession, as well as those who desire to enter it.

Dick R. Turner,
The Refinery Engineering Company,
P. O. Box 1558, Tulsa

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What's Happening in the Industry . . .

Mines Bureau Reports Refinery Capacity Rise

The average petroleum refinery in the U. S. boosted its capacity to process crude oil by nearly 1500 barrels a day during 1953, according to a Bureau of Mines report recently released by the Department of Interior.

The report, reflecting results of the Bureau's annual survey of capacities at crude oil refineries, including cracking plant, shows thruput capacity at the average refinery was 23,759 barrels a day as of January 1, 1954. This compares with 22,270 barrels a day a year earlier. Despite the drop in the number of operating refineries from 343 to 337 during 1953, total daily capacity rose from 7,638,661 to 8,006,897 barrels, an increase of more than 368,000 barrels.

Additional crude oil capacity totaling 397,500 barrels was reported under construction at the beginning of 1954. Accounting for 129,500 of this total are facilities for new refineries; three in North Dakota, two in Washington and one each in Ohio and Utah. The balance is reported as additions to existing facilities.

Atmospheric Pollution Studied—

A research scientist at New York University's College of Engineering adjusts the smokestack on a miniature oil refinery steam plant undergoing wind tunnel studies for Esso Standard Oil Company to determine factors in eliminating or reducing atmospheric pollution. By simulating surrounding buildings, wind, terrain and other conditions in a special low-speed tunnel stack heights and other arrangements can be determined which most effectively disperse pollutents. The complete model scales 16 feet to the inch and represents the company's Baltimore refinery.

To simulate actual gases and temperatures, an oil fog is sent through miniature stacks in the model. A controlled propeller at one end of the tunnel produces various wind velocities. Various wind directions can be simulated by rotating the model. In these tests the smoke density is deliberately exaggerated to aid in plotting the course of the stack emissions.

Smith New President of Reorganized American Oil

D. J. Smith was elected president of The American Oil Company at the first meeting of the board of directors of the newly reorganized company last month. Robert E. Wilson, of Chicago, was named chairman of the board. Other officers are those who have served heretofore in this group of companies.

As a result of the reorganization, the company will operate refineries at Baltimore, Md., and Savannah, Ga., as well as the new 35,000-barrel-a-day refinery near Yorktown, Va., on which work is now in progress. In addition, the company will continue to market the output of the Texas City, Texas, refinery operated by its subsidiary, Pan American Refining Corporation. The company's crude oil production, gas production, and pipe line facilities will be operated by other subsidiaries, Pan American Production Company, Pan American Gas Company, Pan American Pipe Line Company and Fairfax Pipe Line Company.

Through the reorganization, American becomes wholly owned by Standard Oil Company (Indiana). Pan American Petroleum & Transport Company, former parent of the group of companies now headed by American, has been merged into Standard.

Affiliated companies which are to be dissolved and their business taken over by American as a part of the over-all reorganization plan include: Pan American Refining Corporation of Delaware, Mexican Petroleum Corporation, Mexican Petroleum Corporation of Georgia, Lord Baltimore Filling Stations, Inc., and May Fuel Oil Corporation.

Indiana Standard Sets Up Administrative Division

Standard Oil Company (Indiana) has established an Administrative division in its Chicago general office Manufacturing department to replace the department's Industrial Relations division. It will cover industrial and public relations, accounting, and other functions.

R. O. Traylor, manager of the Industrial Relations division since 1952, has been named manager of the new division. L. J. Frodin, former superintendent of the Industrial Relations division, will be assistant manager. M. H. Madsen, administrative assistant to the general manager of manufacturing since 1952, will be supervisor-procedures in the new division.

Indiana Standard Elevates Alan Groh to Group Leader

Alan B. Groh has been promoted to group leader in the Pilot Plant division at the Whiting, Ind., research laboratories of Standard Oil Company (Indiana). Groh joined Standard in 1947.

Standard Dimensions Set For Quart Motor Oil Can

Quart motor oil can dimensions have been made uniform in a new American Standard—B64.1 - 1954. This standard will benefit oil companies, the packaging industry, service stations and manufacturers of cans and machinery for filling and closing cans.

Standard quart oil cans will run through the filling and closing machines of an oil company, regardless of the make of the machines or the cans. Furthermore, cans made according to the new American Standard can be easily packed in cartons of the same size and may be displayed to better advantage on standard-size racks in service stations. Can manufacturers benefit by this uniformity because they can supply the same can to all oil companies.

Donnell Replaces Moore as Ohio Oil Vice President

John R. Donnell, assistant manager of the Supply and Transportation department of The Ohio Oil Company,

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What's Happening. . .

has been elected a vice president and a director of the company and appointed manager of the department.

Donnell succeeds O. F. Moore, director and vice president in charge of the company's supply and transportation activities, who has retired.

Texaco Appoints Three New Departmental Heads

Three new departmental general managers have been appointed by The Texas Company.

Malcolmson

Kuhn

Mangelsdorf

Dr. Wayne E. Kuhn was named general manager of the newly-created Research and Technical deparmtent; James V. C. Malcolmson, general manager, Marine department; and Theodore A. Mangelsdorf, general manager of the Refining department.

Dr. Kuhn has been manager of the Company's Technical and Research division since September, 1938. Until recently, the research organization of The Texas Company had functioned as a division of Refining. As the Research and Technical department, it now has departmental status.

Malcolmson has been assistant general manager of the Marine department since January, 1952.

Mangelsdorf has been manager of the Operations division of Texaco's Refining department since August, 1953.

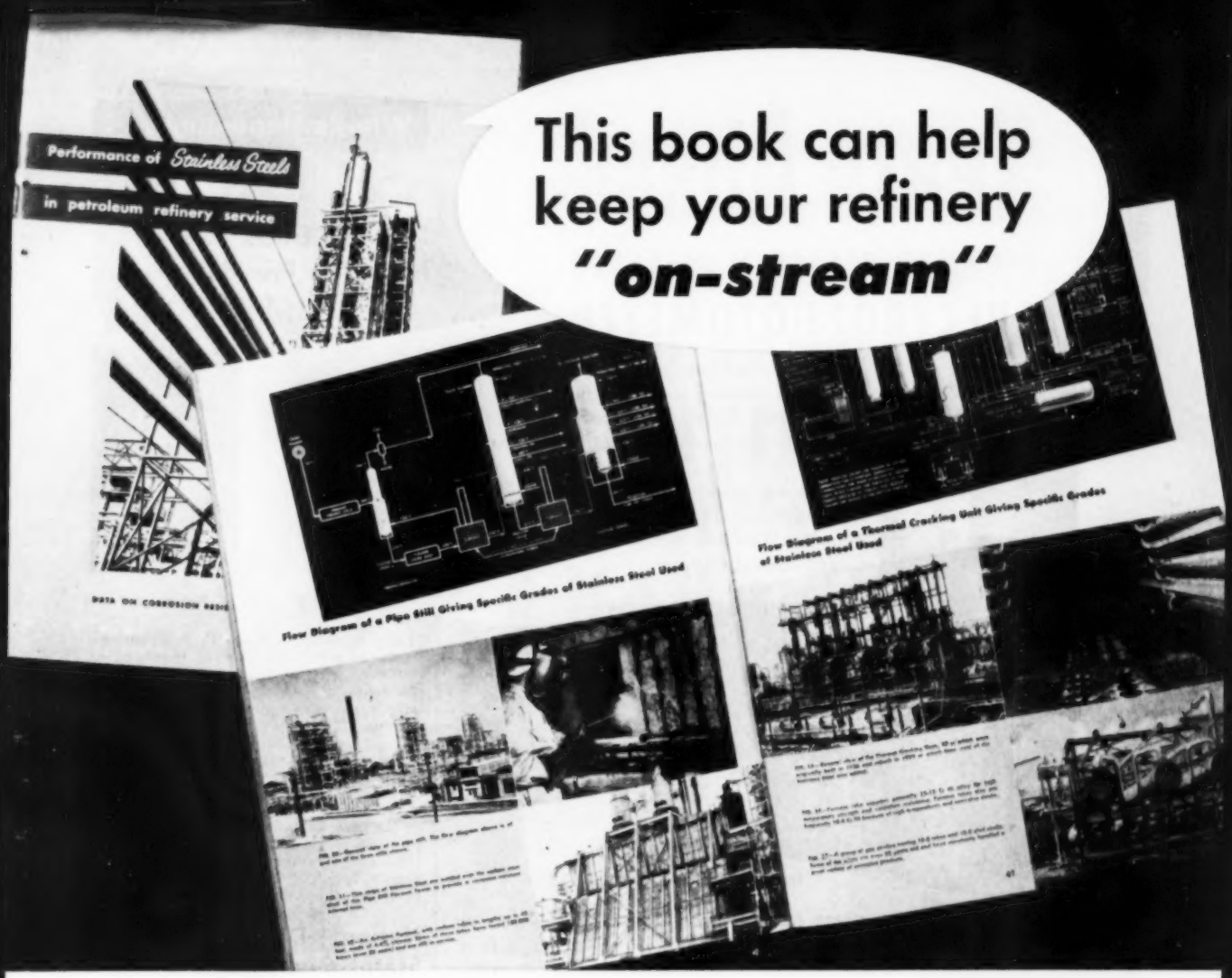
Gulf Appoints Branson Tax Department Manager

Fred B. Branson, assistant comptroller, has been appointed manager, Tax department for Gulf Oil Corporation and its subsidiaries. He succeeds Samuel Johnson, who is retiring after 33 years of service.

William T. Grummer, manager, Accounting, has been elected an assistant comptroller of the corporation and subsidiaries, and will supervise Production, Pipe Line, and Research accounting and related activities, succeeding Branson.

Robert H. Leitch, Jr., assistant manager, Accounting, has been appointed manager, Accounting, succeeding Grummer.

The activities of all three men will be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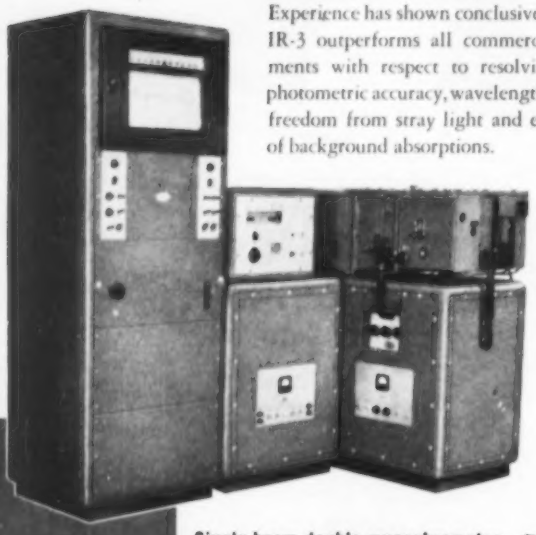

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What's Happening. . .

under the direct supervision of W. L. Naylor, vice president and comptroller.

Pure Oil Elects Two New Vice Presidents

Two new vice presidents have been elected at The Pure Oil Company.

Watson

Gammelgard

The new officers are P. N. Gammelgard, of Chicago, general manager of refining, who becomes vice president for refining with direction of the company's network of refineries; and Dr. Kenneth M. Watson, of Lake Zurich, Ill., director of research, who becomes vice president for research and development.

Gammelgard joined Pure Oil in 1934 as a clerk in the Mechanical department at the Toledo, Ohio, refinery. Dr. Watson has been with the company since 1952 as director of research at the company's research and development laboratories at Crystal Lake, Ill.

National Distillers States Chemical Position

National Distillers Products Corporation has announced that it is still very much a part of the chemical field. In apparent answer to speculation arising from its recent sale of the U.S.I. antifreeze, resin and insecticide activities, the company said the move was merely a reorientation of its chemical program to meet certain longterm objectives, which include integration of its chemical activities.

The recently announced sale of its Insecticide division and its Fairfield, Baltimore, Md., plant did not include the sale of other products such as methionine, ethyl acetate and esters, ethyl acetoacetate and arylids, and ether. These operations will continue at Fairfield until National constructs new facilities for these products at other locations. In addition to these new facilities, National Distillers has several other projects either under construction or planned.

Humble Promotes Souby To Research Specialist

Promotion of A. M. Souby to research specialist in the Research & Development division at its Baytown, Texas, refinery has been announced by Humble Oil & Refining Company. As a research specialist Souby will work on catalytic conversion with emphasis on the appli-

For more data on advertised products, use Readers' Service Cards, last page.

The Beauty of Functional Design

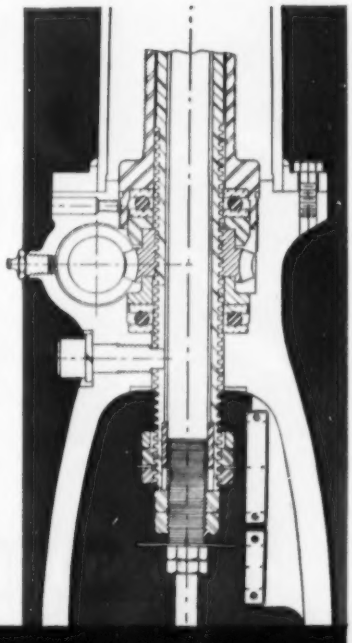
COMPLETE Information in Bulletin 109-A

IN THE **HAMMEL-DAHL**

CONTINUOUSLY CONNECTED HANDWHEEL...

Achieved by integrating parts in the ***compact, completely enclosed*** gear housing illustrated below.

- STRAIGHT-LINE LIFT—No side thrust is exerted against the valve stem.
- COMPLETELY UNHAMPERED AUTOMATIC OPERATION—Permits limiting of valve lift if desired—but in the neutral position the handwheel mechanism offers *no resistance* to valve stem movement.
- INITIAL LUBRICATION LASTS INDEFINITELY.



HAMMEL-DAHL COMPANY

175 POST ROAD, (WARWICK) PROVIDENCE 5, R. I., U. S. A.

SALES OFFICES IN ALL PRINCIPAL CITIES

MANUFACTURING PLANTS IN WARWICK, R. I., U. S. A., CANADA, ENGLAND, FRANCE AND HOLLAND

CANADIAN MANUFACTURING AFFILIATE—GUELPH ENGINEERING CO., GUELPH, ONT.

VISIT OUR BOOTH 410-412, FIRST INTERNATIONAL INSTRUMENT EXHIBIT—PHILADELPHIA, SEPTEMBER 13 THRU 24

For more data on advertised products, use Readers' Service Cards, last page.

Safer than Slippery Flooring

A matador is aware of the risks in his job but because SLIPPERY FLOORS GIVE NO WARNING—often look safe—workmen can be killed or hurt before they know *their* danger! A practical remedy is A. W. SUPER-DIAMOND—tough, rolled-steel floor plate with an exclusive, engineered raised-diamond surface. SUPER-DIAMOND puts 40 anti-slip traction points in every footstep—gives maximum foot safety at low cost. Investigate SUPER-DIAMOND for accident prevention. Write for new Booklet SD-17.

A.W. SUPER-DIAMOND

Economy Rolled Steel Floor Plate

ALAN WOOD STEEL COMPANY

CONSHOHOCKEN, PA.

Other Products: A.W. ALGRIP Abrasive Rolled Steel Floor Plate Plates • Sheet • Strip • (Alloy and Special Grades)

What's Happening. . .

cation of chemical kinetics to process development and design. He joined Research & Development at Baytown in 1939.

O'Kelly and Brandt Draw Pan American Assignments

Dr. Arlie A. O'Kelly has been appointed director of research and Dr. Preston L. Brandt coordinator of research at Pan American Refining Corporation.

O'Kelly

Dr. O'Kelly will be responsible for directing the company's basic research activities in both the petroleum and petrochemical fields. For the past four years he has been technical director at Alox Corporation.

Dr. Brandt, formerly associate director of research, will have primary responsibility for following the progress of academic, institutional, and government research in fields of interest to the company.

Retirements Bring Changes In Socony Organization

Changes in management at Socony-Vacuum Oil Company, Inc., refineries at East Providence, R. I., and Olean, N. Y., to fill vacancies created by retirements have been announced by the company's headquarters in New York.

Hamilton P. Caldwell, Jr., becomes manager of the East Providence refinery, replacing Henry A. Rickett, who will serve as consultant to the refinery's management until his retirement at the end of the year with more than 40 years service.

Caldwell, who joined General Petroleum Coporation, Socony's West Coast affiliate, in 1934, has been assistant superintendent at the East Providence refinery since 1953. Rickett joined the old Standard Oil Company of New York as a research chemist in 1914, transferring to the East Providence refinery in 1919.

Frank V. Williams has been appointed manager of the Olean refinery, assuming the post formerly held by Walter E. Wanner, who has retired under the company's annuity plan after 38 years in Olean.

Williams, formerly assistant superintendent at Olean, will be in charge of the recently announced shutdown of the Olean refinery. After this operation, Williams and other employes not eligible for special retirement or termination arrangements will be offered posts at one of the company's 13 other refineries. Wanner joined the Olean refinery as assistant to the chief engineer in 1916 and advanced through various positions to become superintendent of the refinery in 1945.

Retirements brought about changes, also, in other areas of the Socony-Vacuum organization.

Bryan S. Reid, general manager of the Chicago division, has retired after 43

For more data on advertised products, use Readers' Service Cards, last page.

POLYRAD CONTROLS CORROSION REGARDLESS OF pH

Specifically developed to control corrosion at low pH, Polyrad is a highly effective inhibitor over the entire pH range encountered in refinery operations. For example, in strong acids, such as HCL with pH under 0.1, Polyrad provides more than 98 per cent protection at temperatures as high as 180°F.

Polyrad, a filming amine inhibitor developed through Hercules research, forms a protective molecular film to shield refinery equipment from hydrogen-ion attack by organic and inorganic acids. From crude units to gas plant areas, Polyrad helps maintain throughput, increases heat transfer, reduces metal loss, and cuts down time for maintenance.

A plus feature of Polyrad is its detergent action which loosens iron sulfide and other scales so the fluid stream can remove them from process equipment.

Polyrad is quickly available from conveniently situated stocks. We would like to work with you in evaluating it under your specific operating conditions. As a preliminary step, write Hercules for descriptive brochure.

Naval Stores Department

HERCULES POWDER COMPANY

976 Market St., Wilmington 99, Del.

POLYRAD®

FILMING AMINE INHIBITOR

NA54-2

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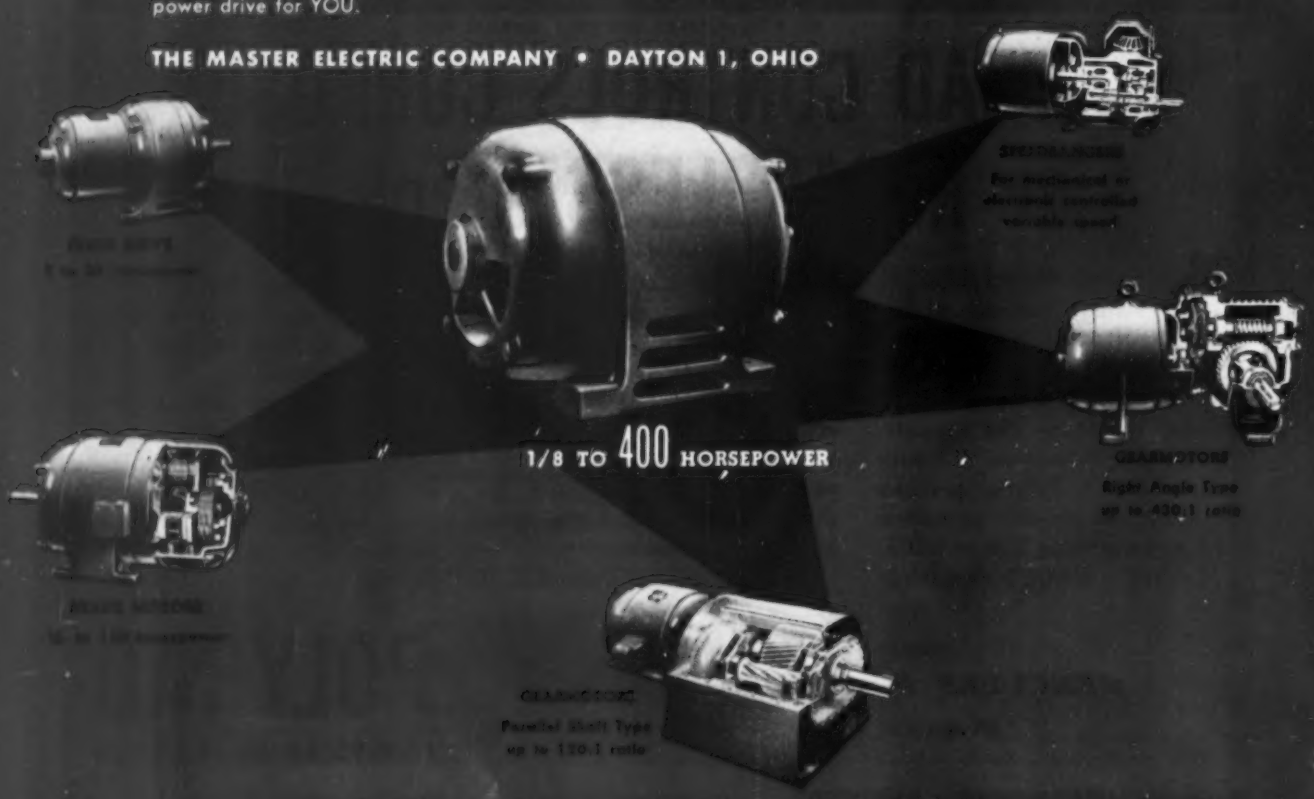
Whenever you select a power unit, don't put a straight-jacket on your ideas . . . consider ALL of the possibilities of modern power drives.

For example consider the many useful combinations that can be secured with the basic Master power units shown below. They're designed so they can be easily combined together to give you the RIGHT horsepower, the RIGHT shaft speed, the RIGHT features in one compact unit that you can use RIGHT where you want it. Nowhere else will you find power units that are so flexible, so easily adaptable, and in such a wide range of types and ratings.

Master power drives are available in thousands and thousands of ratings (⅛ to 400 HP) . . . in open, enclosed, splash proof, fan cooled, explosion proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 430 to 1 ratio . . . with electric brakes . . . with fluid-drive . . . with mechanical or electronic variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best power drive for YOU.

give your brains a chance

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO



What's Happening. . .

years in the oil industry. He has been succeeded by John B. Wilbor, assistant general manager of the Chicago division since November 1, 1953. Reid started in the industry in 1911, working for a firm drilling in Cuba. He joined the Socony-Vacuum organization when Wadhams Oil Company, at which he was assistant to the president, became part of Socony-Vacuum.

George A. Round, chief automotive engineer of Socony-Vacuum, has retired from the Automotive division of the Lubricating department after 40 years of service. Leonard Raymond, formerly assistant chief automotive engineer, has succeeded him. Round first joined Vacuum Oil Company as an automotive engineer in 1914, continuing in this position with the newly formed Socony-Vacuum in 1932.

Jersey Standard Names Moore to Economics Post

Moore

Thomas W. Moore has been appointed assistant manager of the Coordination and Petroleum Economics department at Standard Oil Company (New Jersey). Moore has been assistant manager of the Supply department of Esso Standard Oil Company since 1953.

Tide Water Associated Elects Thomas to Board

Joseph A. Thomas has been elected a member of the board of directors of Tide Water Associated Oil Company.

Thomas, a partner of Lehman Bros., New York investment bankers, is a director of many corporations, including American Export Lines, Flintkote Company and National Airlines, Inc. He replaces John Hertz, a member of Tide Water's directorate since May 6, 1937. Hertz, a senior partner of Lehman Bros., terminated his Tide Water directorship in order to devote his entire time to his many other interests.

Clark Promotes Palmer To Regional Manager

Kenneth J. Palmer, former St. Paul division manager for Clark Oil and Refining Company, has been promoted to regional manager.

In his new position, Palmer will have supervision of the company's Minnesota and Wisconsin operations covering the Brainerd and St. Paul, Minn., divisions and the Green Bay, Wis., division. He has been with Clark since 1939.

At the same time, Tom Sendecky was named St. Paul division manager.

Traynor Leaves Champlin

A. E. Traynor, vice president and director of all marketing activities for

Trapping Methods Inefficient?

Switch to Clark DUO-STEP Leverage

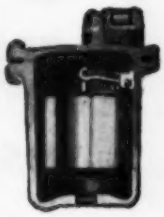
Exhaustive tests prove that Clark Duo-Step Steam Traps boost trapping efficiency over 100% beyond the drainage capacity engineers have come to expect from ordinary old-fashioned steam traps.

By using the patented double fulcrum principle, Clark Duo-Step Traps can handle *twice* the usual volume of condensate and can save you money on both the original purchase and upkeep.

Give Clark Duo-Step Steam Traps a trial on your steam lines and learn about true steam trap efficiency.

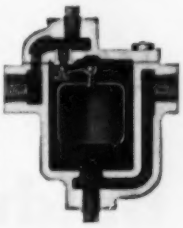
Write, wire or phone for the name of our nearest representative.

CLARK "701"-D (DUO-STEP) TRAP. A forged steel trap for pressures up to 500 P.S.I. and temperatures of 750°F. Equipped with "double-drainage" Duo-Step Leverage and Venting, Clark-loy seats and discs. Pipe sizes ½" or ¾".



SERIES "80"-D (DUO-STEP) TRAPS. Cast semi-steel construction for pressures up to 250 P.S.I. and temperatures to 450°F. Equipped with Duo-Step Leverage and Venting, Clark-loy seats and discs. Pipe sizes from ½" to 2".

"Y" SELF-CLEANING STRAINERS. Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S.



CLARK "60-D" (DUO-STEP) TRAP. Cast semi-steel construction, designed for pressures up to 200 P. S. I., temperatures to 400°F. Duo-Step levers and brackets of stainless steel construction. Seats and discs are of Clark-loy. ½" or ¾" horizontal inlet and outlet connections with ¼" test outlet and drain plug. Vertical inlet can be furnished in ½" or ¾" size.

THE HOME OF DUO-STEP LEVERAGE

Clark

MANUFACTURING COMPANY

1830 EAST 38th STREET

CLEVELAND 14, OHIO

Distributors and Representatives in all major cities

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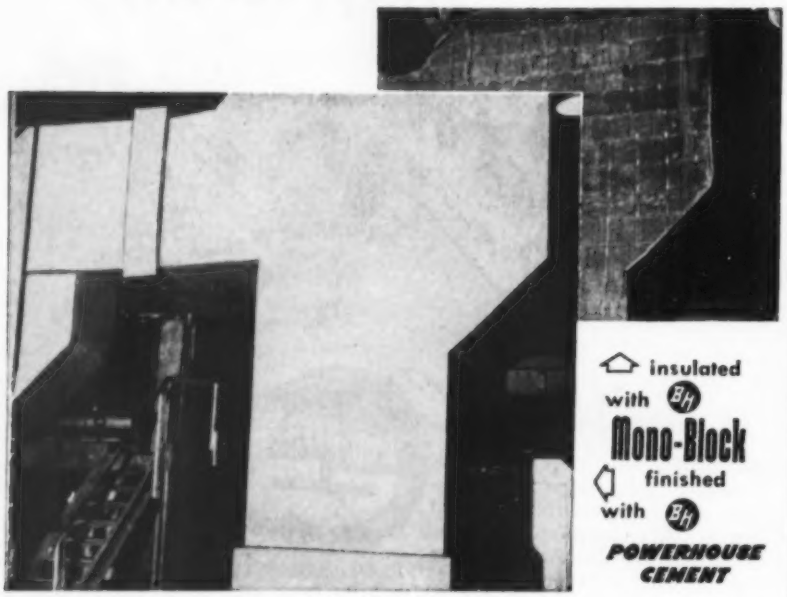
PETROLEUM
REFINER for ideas?



insulated with B-H Mono-Block finished with B-H POWERHOUSE CEMENT

BALDWIN-HILL
POWERHOUSE CEMENT.....
INSULATES AND FINISHES

- Easy trowelling... Single coat... Low applied cost.
- Quick hydraulic setting... No drying-shrinkage cracks.
- Weatherproof, "rain-proof" within two hours.
- Smooth surface for oil and water-base paints.

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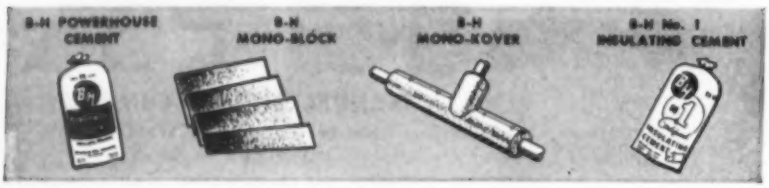
709 BREUNIG AVE., TRENTON, N. J.
Kalamazoo, Mich. • Huntington, Ind. • Temple, Tex.

Send for bulletin with data on composition, properties, efficiency and low applied cost.



What's Happening...

Champlin Refining Company, which was recently purchased by Chicago Corporation, has resigned. His successor has not been named.

Kelly Succeeds Sitler As Esso Purchasing Head

Albert J. Kelly has been appointed general manager of the Purchasing department of Esso Standard Oil Company, to succeed Joseph M. Sitler, a director and head of purchasing, who has retired after 33 years service with the company.

Kelly

Sitler

In addition, Bertram A. Warren and John W. Rush were named assistant general manager and assistant to the general manager of purchasing, respectively.

Sitler went with Standard Oil Company (New Jersey) in 1921 after nine years in the U. S. Navy's Bureau of Supplies and Accounts. He became assistant purchasing agent for the operating company, now known as Esso Standard, in 1927, and a year later became general purchasing agent for Humble Oil & Refining Company in Texas. Rejoining Esso in 1935 as assistant purchasing agent, he was elected to the board in 1941 and named director of purchasing in 1942.

Kelly has been with the company's purchasing activities since joining the company as a buyer in 1919, and has been general purchasing agent since 1948.

Warren, who joined Esso 31 years ago, has served as assistant general purchasing agent since 1953.

Rush first joined the company at the Bayonne, N. J., refinery, transferring to the Purchasing department in 1923. He has been assistant to the general purchasing agent since 1950.

Gay Succeeds DuPont as Member of Phillips Board

Phillips Petroleum Company has announced the election of T. S. Gay, vice president and assistant secretary in charge of its New York office, to the company's board of directors. He replaces Eugene E. DuPont, who recently resigned after 35 years of continuous service as a director.

Sinclair Chemicals Moves To New New York Offices

Sinclair Chemical, Inc., subsidiary of Sinclair Oil Corporation, has moved its

For more data on advertised products, use Readers' Service Cards, last page.

ARE CLOGGED LINES LIKE THESE CUTTING YOUR WATER SUPPLY?

Over 1½ Miles of Buried Water Line Chemically Cleaned IN PLACE by Dowell Service

You don't have to dig up water lines in order to clean them! Take the case of a major railroad that had over 8600 feet of *buried* water lines, ranging from 2 to 12 inches in diameter. The capacity of these lines had been greatly reduced by scale deposits. Dowell Service used liquid solvents to clean all the lines, *in place*, during a period of only six days with a minimum interruption in service.

Dowell Service offers *fast*, effective chemical cleaning of pipelines of all kinds—water lines, disposal lines and product lines. And, whether these lines are underground or above, indoors or out, no digging or dismantling is necessary. Dowell solvents are designed to dissolve the accumulated deposits, and are introduced through regular connections. Because they are liquid, Dowell solvents reach wherever steam or water can flow, cleaning places inaccessible by other methods—angles, curves, valves, complicated surfaces and hook-ups. *Experienced* Dowell engineers do the job using Dowell-designed truck-mounted pumps, mixers and control equipment.

Many other types of equipment can also be cleaned chemically by Dowell. If you have boilers, condensers, evaporators, bubble towers, water wells or other operating equipment where deposits are reducing capacity, let Dowell Service *save you time and money in maintenance cleaning!*

FIND OUT ABOUT CHEMICAL CLEANING! There are many places in your plant where Dowell Service can clean equipment faster and better than out-dated mechanical methods. Call your nearest Dowell office for a fact-filled book. Or write direct to Tulsa, Dept. I-31.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED
Tulsa 1, Oklahoma

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

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Barco Flexible STRUT* Joints

*For Structural Applications

—for Refinery TOWERS STACKS • LARGE PIPING

Barco Flexible Strut Joints are an important aid in *modern* refinery construction. A typical use is at the ends of struts for supporting or bracing large catalyst carrier lines or vent stacks on fluid catalytic crackers. In such cases, where horizontal lines require supports, two braces (with Barco Flexible Strut Joints in each) make costly "A" frames unnecessary. Other uses include the guying of tall vessels and columns and directing thermal movements of high temperature piping.

The Modern Way **to handle**

- **STRESS LOADS**
- **VIBRATION**
- **WIND SWAY**
- **THERMAL MOVEMENTS**

SIMPLE, VERSATILE!—The Barco Strut Joint is a dependable, compact, versatile fitting requiring practically no maintenance. It is a simple ball and socket that provides a point of flexibility in struts and guy rods. The close fit between the ball and the casing, allows for reversible loads, not possible with pin and clevis type braces. Barco Strut Joints support without restricting freedom of movement of piping.

COMPLETE LINE—Barco manufactures Strut Joints in the following sizes and load capacities: 1"—6,000 lbs., 1½"—8,000 lbs., 2"—12,000 lbs., 3"—20,000 lbs., 4"—50,000 lbs., 6"—130,000 lbs. Joints are made with welding ends for field or shop use. Unique "Bar-Moly" treatment of wearing parts provides a permanent dry lubrication for long service with little or no maintenance.

ENGINEERING SERVICE—Barco will be glad to work with your engineers in the selection of joints to meet your requirements. *Specifications and information on request.* BARCO MANUFACTURING CO., 542K Hough St., Barrington, Illinois.

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS FOR CONVEYING FLUIDS

What's Happening. . .

New York offices to the Sinclair Oil Building, 600 Fifth Avenue.

Sohio Makes Changes in Manufacturing Department

Organizational appointments in its Manufacturing department have been announced by The Standard Oil Company (Ohio).

Cuthbert

J. R. Cuthbert, manager of the No. 1 refinery, will become deputy assistant to the vice president in charge of manufacturing. This position was created by the company to facilitate the coordination of administrative activities and the handling of special problems.

J. S. Dalton, general superintendent of the No. 1 refinery, will succeed Cuthbert as manager.

G. R. Thompson, assistant general superintendent of the No. 1 refinery, will become general superintendent. The position of assistant general superintendent will be suspended as a current component of that organization structure.

F. G. Brown, manager of the Latonia refinery of Sohio Petroleum Company, will become a consultant in refining until his normal retirement in June, 1956.

Ray Elo, of Latonia, will assume the managerial administration of Latonia refinery as general superintendent.

Caltex, Socony Overseas Get Together in Lebanon

Socony-Vacuum Overseas Supply Company has purchased half of California Texas Oil Company's 100 percent stock interest in Mediterranean Refining Company, which is currently building a refinery at Sidon, Lebanon. The Mediterranean plant will turn out more than 6500 barrels a day of products for consumption in Lebanon.

ERRATA

Page 103 of the August issue had two figures incorrectly labeled:

Figure 4 (upper right) should read: **"Side-entering propeller mixer position."**

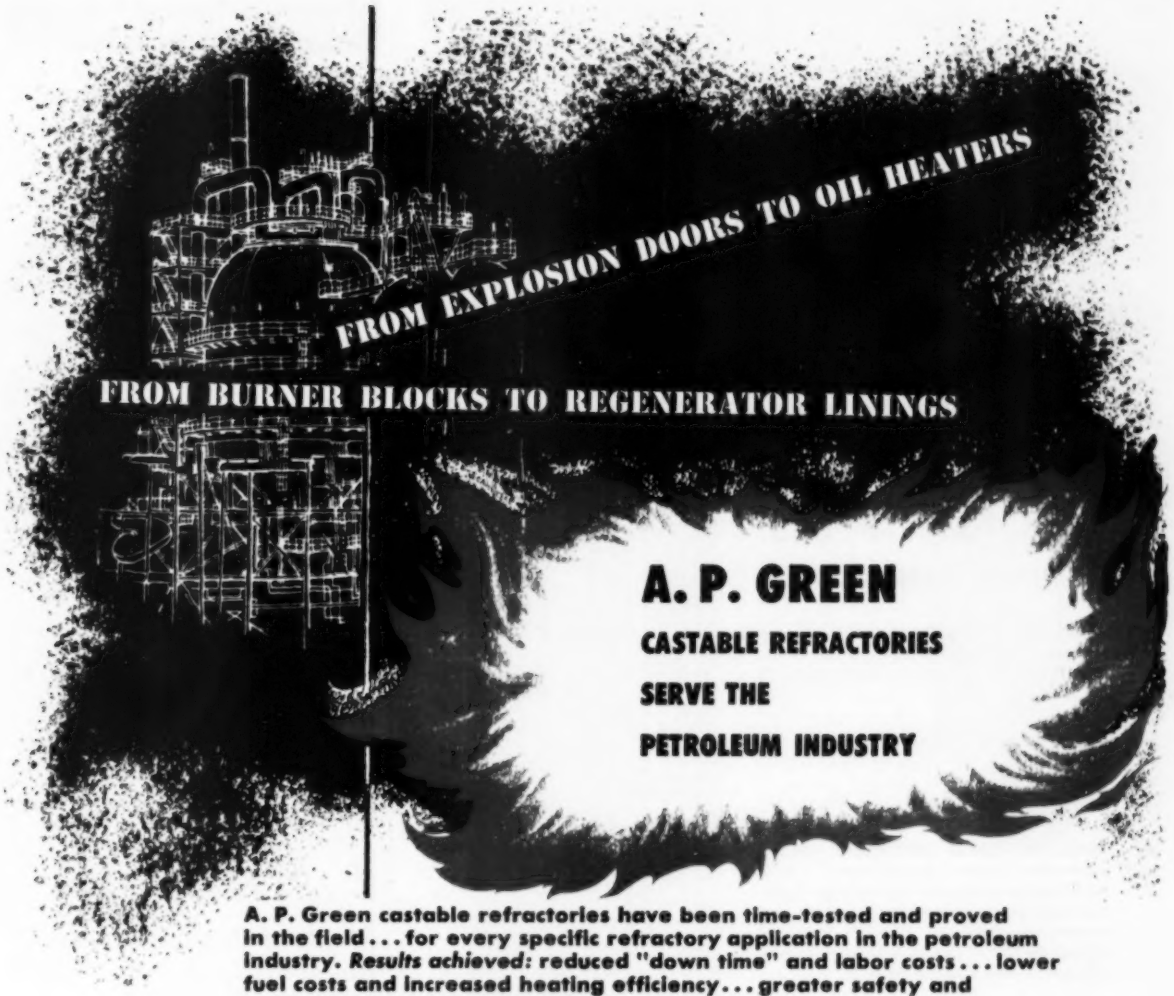
Figure 5 (center at bottom) should read: **"Introducing liquid during mixer operation."**

These were in the J. H. Rushton article "Mixers for Large Tank Blending."

General Petroleum Names Industrial Relations Man

C. F. Coffin has been named industrial relations manager at the Torrance, Calif., refinery of General Petroleum Corporation. He also will be concerned with the Manufacturing department's operations at Vernon, Calif.

Coffin, who joined General Petroleum in 1934 as a truck driver, was formerly



A. P. Green castable refractories have been time-tested and proved in the field . . . for every specific refractory application in the petroleum industry. *Results achieved:* reduced "down time" and labor costs . . . lower fuel costs and increased heating efficiency . . . greater safety and reduced maintenance control.

For detailed information and specific recommendations . . . write, Engineering Department, A. P. Green Fire Brick Company . . . or call your local A. P. Green distributor.

A. P. Green Castable Refractories . . . designed to exact specifications to do an exact job

KAST-SET — A rapid setting, high strength refractory castable. Mixed with water, it takes on a hydraulic bond without the application of heat. KAST-SET will not shrink, has excellent resistance to abrasion, and is ideally suited for monolithic linings. It may be used at temperatures up to 2700° F.

KAST-O-LITE — A lightweight castable recommended for temperatures up to 2500° F. It is used for monolithic linings in all types of stills and heaters, tar stills, heat treating furnaces, flues, and stacks. Reduces heat loss. Insures closer temperature distribution and control.

CASTABLE INSULATION NO. 20 — A hydraulic-setting castable for temperatures up to 2000° F. Recommended for complete monolithic linings and lightweight panel construction in oil stills and heaters. Weighs 50 pounds per cubic foot in place.

CASTABLE BLOCK MIX — A hydraulic-setting castable insulation for temperatures up to 1600° F. CASTABLE BLOCK MIX combines the advantages of a castable material with low conductivity and light weight. It provides maximum insulating efficiency and ease of installation. Weighs only 20 pounds per cubic foot in place.

CASTABLES FOR GUN APPLICATION . . . SK-7 — Gun application of SK-7 produces a lightweight lining with excellent strength and insulating efficiency for temperatures up to 1800° F. Installation and labor costs are reduced . . . no forms required. Ideal lining for ducts, flues and breechings.

KS-4 — This strong abrasion resistant castable can be gun applied with a minimum of rebound loss. Recommended for catalytic regenerator linings, stack linings, bubble towers, and duct linings exposed to abrasion or corrosion. For temperatures up to 2550° F.

A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK CO., MEXICO, MISSOURI, U. S. A.

In Canada, **A. P. GREEN FIRE BRICK CO., LTD.,** TORONTO 15, ONTARIO

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD

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4 reasons why

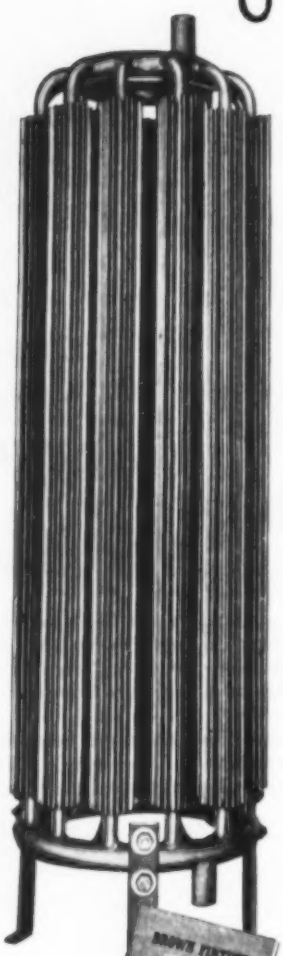
BROWN FINTUBE TF-18 TANK HEATERS HAVE OBSOLETED OLD FASHIONED TANK COILS

1) **LOWER COST**—Users report that the cost of TF Heaters plus their installation is usually less than the cost of just installing bare pipe coils of equivalent capacity.

2) **VERTICAL MOUNTING**—on legs about 10" above the tank floor brings the entire heating surface in contact with the tank contents—avoids heating through a layer of sediment.

3) **MUCH INCREASED EFFICIENCY**—Finned construction provides approximately 7 times more heating surface per foot of tube length than plain bare pipe—permits more heat to be transferred—faster—at lower temperatures per square foot of surface, avoiding coking or damage to heat sensitive products.

4) **EASY INSTALLATION**—TF-18 heaters pass easily through a standard manhole permitting installation in new or existing tanks. They do not require welding inside the tank. Manifolded into groups or individually trapped.



You can't keep your operations competitive with old fashioned, obsolete methods. Write today. Get full details about these new, fully proved, less costly, more efficient tank heaters.

New fully descriptive Bulletin No. 541 gives dimensions and full details. Write for your copy today.

Brown Fintube Co. *Elyria, Ohio*

NEW YORK • BOSTON • PHILADELPHIA • PITTSBURGH • BUFFALO • CLEVELAND • CINCINNATI • DETROIT
CHICAGO • ST. PAUL • ST. LOUIS • KANSAS CITY • MEMPHIS • BIRMINGHAM • NEW ORLEANS
SHREVEPORT • TULSA • HOUSTON • DALLAS • DENVER • LOS ANGELES • SAN FRANCISCO
BROWN FINTUBE (CANADA) LTD., ST. THOMAS, ONTARIO, CANADA
BROWN FINTUBE (GREAT BRITAIN) LTD., BIRMINGHAM, ENGLAND
FRIEDRICH UHDE, GMBH, DORTMUND, GERMANY

What's Happening. . .

an industrial relations representative at the Torrance refinery.

Iran Plant in Condition To Start Operations Soon

The Abadan refinery, center of the recently settled dispute, is believed to be in good enough condition to start higher level operation under the Iranian oil agreement as soon as Iran's parliament ratifies the formal agreement. It is believed that producing and loading operations can be started at the same time. Hope is that ratification will come by October 1.

Spare parts are needed for some refinery units, and metal inspection of pressure vessels, as well as inspection of producing and loading facilities, is yet necessary. Aside from this, the plant should start operating without a hitch.

Enjay Forms Division To Market Butyl Rubber

If the bid which Esso Standard Oil Company has submitted for the government Butyl rubber plant at Baton Rouge, La., is accepted, Esso will market its production through Enjay Company. Humble Oil & Refining Company, another affiliate of Standard Oil Company (New Jersey), has reported similar intentions for marketing a substantial quantity of Butyl rubber if it acquires the Baytown, Texas, Butyl plant.

Enjay Company has announced the formation of a Rubber division under A. Bruce Beohm, vice president, to handle servicing of Butyl and Vistanex sales.

Stanford Research Adds Miller to Chemistry Staff

Allyn C. Miller, former technical operations supervisor of California Research and Development Company, has joined the staff of Stanford Research Institute as an assistant chairman of the Chemistry department.

He will supervise project work in the chemical, metallurgical and ceramic engineering section as well as in air research.

Before joining the Livermore research organization, where he was doing work for the AEC, Miller was president of Mill-Hall, Inc., manufacturers of chemical specialties at Richmond, Calif.

Bertetti Succeeds Hoffman On Pan-Am Southern Board

Dr. J. W. Bertetti, general manager of manufacturing, has been elected to the board of directors of Pan-Am Southern Corporation. He will succeed M. C. Hoffman, formerly vice president in charge of exploration and production.

Hoffman was recently transferred to an executive post with Stanolind Oil and Gas Company, the exploration and production subsidiary of Standard Oil Company (Indiana), after Pan-Am's exploration and production activities were transferred to that organization.

Dr. Bertetti has been general manager since December, 1952.

What's Happening . . .

Tide Water Transfers Griffith to Tulsa Post

T. Ed Griffith has been promoted from senior engineer in the Gas Utilization department at Houston to supervisor of gas and gasoline plant operations in the Central divisions of Tide Water Associated Oil Company at Tulsa.

Griffith

Prior to joining Tide Water in February, 1948, he taught chemical engineering at Oklahoma A. & M., and obtained his M.S. degree in chemical engineering at the University of Michigan.

While in Houston in his former capacity, Griffith was a part-time instructor of gas engineering in the Petroleum Engineering Department of the University of Houston.

Standard Oil Development Switches Yowell, McLean

Howard L. Yowell, head of the Motor Lubricants and Wax section in the Esso Laboratories of the Standard Oil Development Company, is scheduled to leave for England this month on a rotational assignment.

In his new position, Dr. Yowell will head the Lubricants sections of the Esso European Laboratories, an affiliate of the Standard Oil Development Company, located in Abingdon, England. This post is now held by Donald H. McLean, who is being transferred to the U. S. to fill Dr. Yowell's position in the company's Esso Laboratories. It is expected that their exchange assignments will last one or two years.

Benedict to Head Stanford Physical Sciences Work

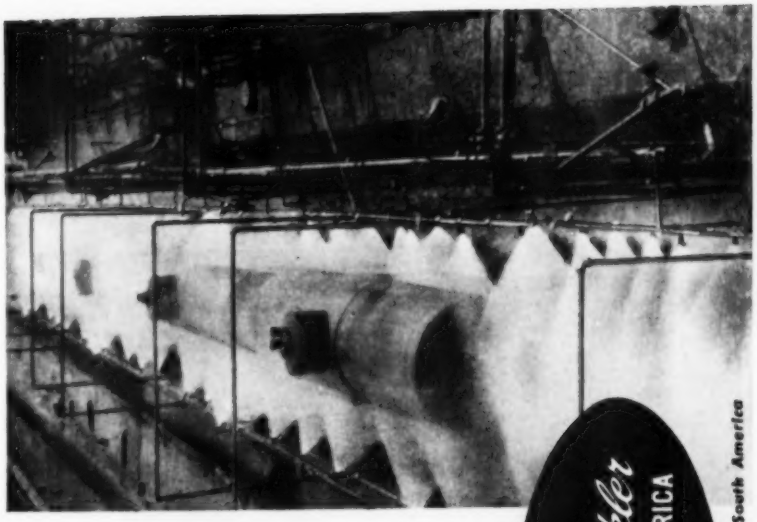
Donald L. Benedict has been appointed director of physical sciences research at Stanford Research Institute, Palo Alto, Calif. He was formerly assistant director of the Engineering division.

Dr. Benedict will supervise all project work and Institute-sponsored research in the fields of chemistry and chemical engineering, metallurgy, ceramics, biochemistry and physics.

Oil's Worker Investment Topped Only by Two Groups

Petroleum companies included in the National City Bank of New York's recent study of the nation's largest manufacturers showed an investment per worker of $41,000, third only to distillers and tobacco groups.

The study covered 100 companies with assets aggregating $69.8 billion at the end of 1953. Total assets of the 20 large integrated oil companies included in the



MAINTAINING PROFITS WITH ENGINEERED "Automatic" FIRE-FOG PROTECTION

Tank car loading and unloading operations are a major hazard to many chemical and petroleum processing plants. Even a localized fire could mean severe loss to business continuity, equipment and profits.

That's why "Automatic" Sprinkler engineers were called upon to design, manufacture and install fire protection as shown in operation at this large West Coast petro-chemical plant. ENGINEERED "Automatic" FIRE-FOG was the answer to this problem. Yours may call for fixed piping systems of "Automatic" Sprinklers, AIR FOAM, CO_2, or some other tried and proved method of fire control and extinguishment. The conditions involved dictate the procedure to follow in providing the proper type of protection "best by test" for any fire hazard.

"Automatic" Sprinklers staff of technically trained engineers as well as Laboratory and Test Yard facilities are available to you without cost. We'd welcome the opportunity to counsel with you as a friend — not just a supplier. There's a common objective in mind . . . safeguarding lives, property and profits from the constant menace of fire.

"Automatic" Sprinkler CORPORATION OF AMERICA YOUNGSTOWN, OHIO

Offices in Principal Cities of North and South America

For more data on advertised products, use Readers' Service Cards, last page.

SCALE OF MILES

0 10 20 30 40 50 100

. . . accurate liquid level gauging- at ANY DISTANCE!

"Varec"

SEE PULSE CODE AT THE INSTRUMENTS SHOW IN PHILADELPHIA, SEPT. 15-21 BOOTHS: 757, 759, 761

PULSE CODE
TELEMETERING SYSTEM
(PATENTS APPLIED FOR)

THE VAPOR RECOVERY SYSTEMS COMPANY has successfully eliminated the one great drawback to accurate transmission of remote tank gauging over long distances – *loss or gain of a part of the signal.*

Through use of the pulse code method of message transmission the system utilizes a separate pre-arranged code for each ⅛" increment of measurement.

At the receiver, the code transmitted by the tank unit is translated into the equivalent measurements – there can be no borderline cases where the reading might fall between two increments. The receiver will either produce the *correct* reading as transmitted *or it will not produce any reading.*

Obviously such an exact system is not confined to liquid level telemetering alone. It can be readily applied to numerous supervisory control problems such as remote control of pump motors, control valves and associated equipment. Thus the complete dispatching operation, gauging and remote control is integrated into one single unitized system when a "Varec" Pulse Code Telemetering System is installed.

The equipment is also capable of providing tank liquid level alarms or warnings of any off-normal conditions at the remote control point. Further, the receiver readings may be fed into automatic printing equipment for a permanent record and automatic sequencing equipment may be added to provide fully automatic tank gauging.

Before you install any type of remote gauging we urge you to thoroughly investigate the "Varec" Pulse Code Telemetering System – write today for complete details.

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COMPTON, CALIFORNIA
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961-2

What's Happening. . .

study aggregated $22.7 million, which compared with a total employment of 555,000.

Humble Division Promotes Atkins at Baytown Plant

Promotion of George T. Atkins to the position of engineering associate at its Baytown, Texas, refinery has been announced by the Engineering division of Humble Oil & Refining Company.

In his new position, Atkins will be concerned with the development of design criteria and with the actual design of some of the larger projects being considered for the Baytown refinery.

Sohio Appoints Morrill to New Petrochemical Post

Edward F. Morrill, president of Mid-Valley Pipe Line Company since August, 1950, has been named general manager of the new Petrochemical division of The Standard Oil Company (Ohio).

F. Hill Sanders, vice president and director of Sun Pipe Line Company and general manager of its Crude Pipe Lines department, is expected to replace Morrill as president of Mid-Valley.

Wark and Brown Promoted

Thomas L. Wark and Charles R. Brown, vice presidents of Tide Water Associated Oil Company, Inc., have been appointed general manager and assistant general manager, respectively, of the company's Western division.

In their new assignments, Wark and Brown, with headquarters in San Francisco, will be in charge of all operations in California, Oregon, Washington, Arizona, Utah, Idaho, Nevada, the Territory of Hawaii and The Philippines.

Bibliography Omitted

In the article, "Air-Cooled Industrial Heat Exchanger," which appeared in our June, 1954 issue, the following references were inadvertently omitted:

Stark, E. L., "Instrumentation on El Paso Natural's Texas-California Line," O & GJ, September 23, 1948, p. 213.

Thornton, D. P., "Water Scarce—Natural Gasoline Plant Uses Air for 80 Percent of Required Cooling," Pet. Proc., Jan. 1947.

Thornton, D. P., "How To Get What You Need When You Order Cooling Equipment," Pet. Proc., July, 1952, p. 958.

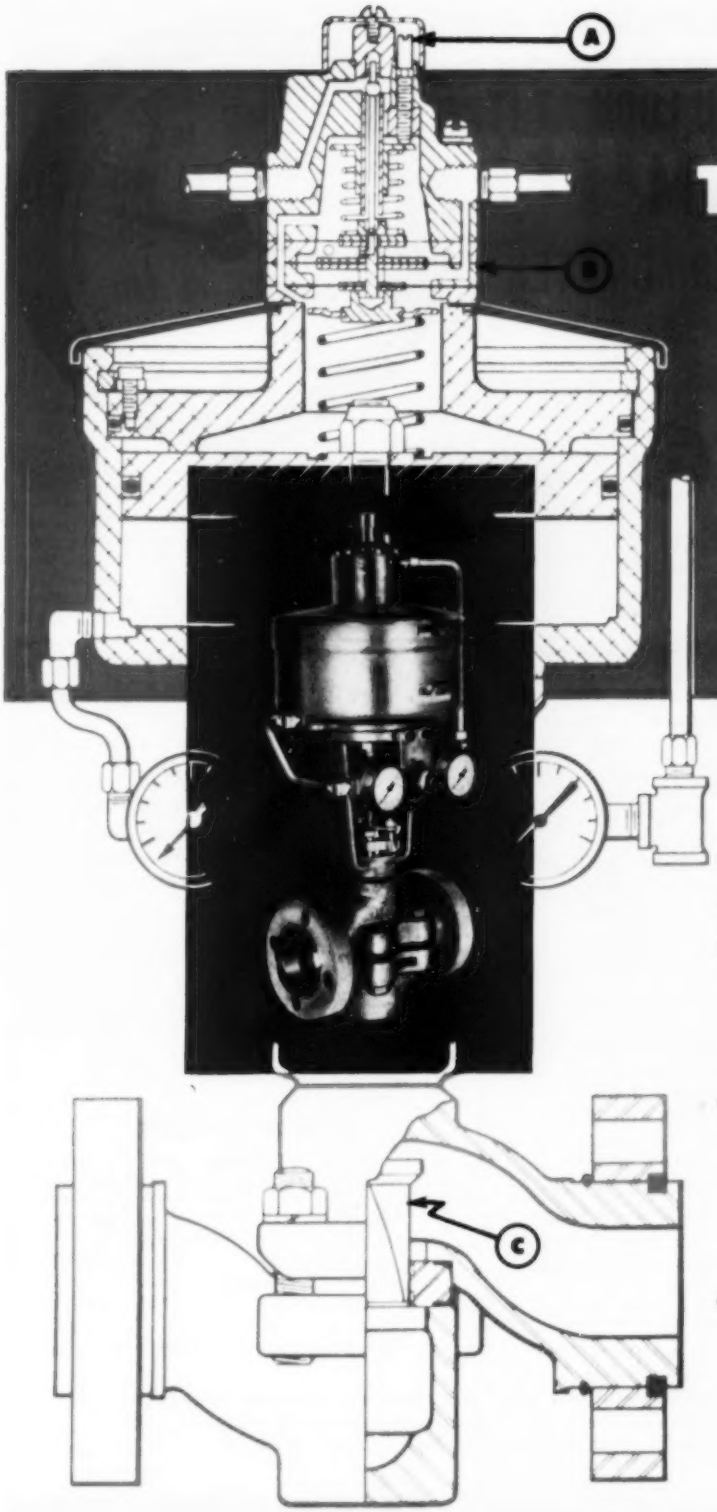
Thornton, D. P., "Air-Cooled Heat Exchangers," Pet. Proc., October, 1947, p. 775.

A fifth reference which provided the basic source material for the article is:

Chase, J. C. and Degler, H. E., "Economics of the Air-Cooled Heat Exchanger," Pet. Engr., January, 1953, p. C-42.

Peppers Resigns Post at Peppers Refining

Charles C. Peppers has resigned as president of Peppers Refining Company, which was recently purchased by The



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CONOMOTOR *Series LB*

CONTROL VALVES

EXCLUSIVE FEATURES

A—External Zero Adjustment—Readily Accessible

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Ingenious pneumatic piping arrangement and exclusive positioner design, permits opening or closing of valve on air failure with either direct or reverse action Coneplug.

Most control engineers agree on the advantages of *single-seated* valves for today's demanding process applications. But in order to successfully operate single-seated valves it is necessary to have better than average topworks . . .

Hence, the revolutionary CYLINDER CONOMOTOR. . . . 10 to 20 times more POWER than conventional spring motors . . . SPEED of response 5 to 10 times faster than diaphragm motors . . . 50% reduction in WEIGHT per unit of delivered power . . . 30% reduction in SPACE requirements . . . STABILITY and positioning ACCURACY unmatched by conventional spring-and-diaphragm or springless diaphragm motors.

The combination of the Cylinder Conomotor with the unique single-seated split body gives industry, for the first time, a fully coordinated valve design. Conomotor Series LB Control Valves meet *all* of industry's rigorous requirements.

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Better ANY WAY YOU LOOK AT IT...

AMERICAN "*Every Angle*" DIAL THERMOMETER

The American "Every Angle" Dial Thermometer is easy to install and turn to any position for accurate face-to-face readings. Specify the "Every Angle" — indoor or outdoor design — and this unbeatable feature combination is yours:

DEPENDABLE ACCURACY. The "Every Angle" Thermometer is made of precision-machined, non-corrosive materials and operates by vapor pressure. It is precisely calibrated against certified standards to assure the most critical reading in the upper third of the dial, where the graduations are farthest apart.

CONVENIENCE. Dial face can be rotated 180° and tilted 180° for accurate reading at the most convenient angle.

WEATHER-PROOF DESIGN. *Screw-type ring* with tight-fitting gasket for weather-proof outdoor service; *slip ring* design for indoors.

REINFORCED MOUNTING. Heavy-gauge swivel hinge has a *stainless steel kingpin.* Reinforced connection between hinge and bulb. Greater strength and corrosion resistance, long service life!

EASY INSTALLATION. Socket connections have compression-type bushings. No costly jigs needed — connection easily welded to tanks or other irregular-shaped equipment.

Ask your Distributor to help you select the American "Every Angle" Dial Thermometers with the proper temperature ranges for your needs. Phone or write him today.

SPECIFICATIONS

NON-CORROSIVE DIAL CASE: Non-corrosive aluminum with smooth black finish. No protruding screw heads. Nickel-plated brass cup houses coiled capillary tubing.

DIAL: 3½" diameter. White with black figures. **POINTER:** Black, adjustable. **FRONT:** Heavy plate glass. **MOVEMENT:** Bronze or stainless steel. **BULB AND STEM:** Stainless steel. **SIZE CONNECTION:** ½", N.P.T. **STEM-LENGTHS:** 3", 5-5/16", 12", 18" and 24". **SEPARABLE SOCKETS:** Bronze, carbon steel or stainless steel.

STANDARD RANGES

Fahrenheit	
—60 to 20°	30 to 300°
—20 to 120°	100 to 300°
40 to 140°	90 to 350°
30 to 180°	190 to 390°
20 to 220°	260 to 450°
Centigrade	
0 to 100°	40 to 150°

YOUR INDUSTRIAL DISTRIBUTOR makes it his business to see that you get the best possible equipment. That's why he handles only products of proved quality and dependability — like Manning, Maxwell & Moore products.

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MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

What's Happening. . .

Chicago Corporation. Peppers has now formed Peppers Petroleum Company to operate in central Oklahoma areas.

What Ideal Additive Must Not Do Cited at SAE Meet

Fuel additives developed to solve one problem should receive additional study to make certain that they do not cause new problems, a research group from Ethyl Corporation told a recent West Coast meeting of the Society of Automotive Engineers at Los Angeles.

In their paper presented to the meeting, A. E. Felt, R. V. Kerley and H. C. Summer outlined the following items which the "ideal" additive must not do: attack fuel system parts, leave deposits in intake system, raise engines' octane number requirement due to combustion chamber deposits or increase its preignition tendencies, increase tendency of spark plug deposits to shorten out plug, increase engine wear, impair engine cleanliness, increase bearing corrosion, shorten intake and exhaust valve life, or increase exhaust system corrosion.

Catalysis Authority Joins Research Staff at Houdry

Dr. Ahlborn Wheeler, international authority on the chemistry of catalysis, has joined the research staff of Houdry Process Corporation. As a member of the Fundamental Research division, Dr. Wheeler will study the catalytic activation of hydrogen.

Dr. Wheeler formerly worked for Shell Development Company, where, with the late Dr. Otto Beeck, he studied the catalytic properties of evaporated metal films. Since 1946 he has been with the Polychemicals department of Du Pont, studying catalytic hydrogenation and reaction rates in catalyst pores.

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Resarch Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

2,3,5,6-Tetramethylbenzoic acid
Thiobenzamide
Succindialdehyde
Piperidine-4-acetic acid
Dilauryl selenide
Octene-3
2,4-Dichlorobenzyl alcohol
Tetraphenylgermanium
Tri(p-nitrophenyl)carbinol
Truxillic acid
1,2,3-Butanetriol
3,3,3-Trichloropropene
p-Phenylphenyl bromide
N-Laurylpiperidine
Chroman-5,6-quinone
Naphthyl isothiocyanate
Decanesulfonic acid
2,4-Hexadienal
Butadiene monoxide
Molybdenum oxyfluoride

FOR VALVES IN CORROSIVE SERVICE

Refinery plants large and small have long been looking for a permanent acid packing for those "hard-to-get-at" valves.

These valve stems must be packed and made tight at all times. A drip from a leaky valve is dangerous to personnel. These acid valves require 1/8", 3/16", 1/4", 5/16" or 3/8" square packing. Up to now braided blue asbestos packing has been considered best and cheapest (60-day life). Today the whole world of packing has been changed by the material "Teflon". Braided yarn packing made of Teflon is replacing all forms of braided packing for acid service because it lasts as long as the valve itself. Practically no acid, diluted or concentrated, hot or cold, has any affect on the packing. (Many records of two-years' service or more have been reported). This is highly important to all Petroleum Engineers and Refinery Plant Operators.

"JOHN CRANE" Style 704 is available in handy coil or spool form in a full range of sizes. A stock of "JOHN CRANE" Braided Teflon Packing in your storeroom may be a life saver for you.

Teflon is recommended on chemicals at any pressure with temperatures ranging from -100°F. to +500°F.

Many Petroleum Engineers prefer "JOHN CRANE" Style 704 Braided Teflon Packings for their service. For the best in mechanical packings fabricated from braided Teflon, contact Crane Packing Company. *Send for this Teflon Technical Bulletin.* Write 1820 Cuyler Avenue, Chicago 13, Illinois.

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JOHN CRANE CRANE PACKING COMPANY

For more data on advertised products, use Readers' Service Cards, last page.

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UPPER and LOWER SIDE CONNECTIONS

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Factory calibrating or zeroing adjustment produces a correct 3 to 15 pound signal output for full float range operation, as particularly required in liquid level indication. Output signal of controller is linear as related to level height change.

Simple level adjustment indicating dial.

Pneumatic proportional band and specific gravity adjustment combined in one member.

Small compact relay unit, minimum working parts.

★ All welds are in accordance with ASME code for unfired pressure vessels.

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- LIQUID LEVEL INDICATION
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Engineered for peak performance the Fisher Series 2500 Level-Trol is designed to give rugged, trouble-free service. It is high in sensitivity and accuracy . . . it is versatile in handling all kinds of liquids, with minimum service attention.

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What's Happening. . .

Hainsworth Named Head of Fluor Research Division

Dr. William R. Hainsworth has been appointed vice president in charge of the Research division of The Fluor Corporation, Ltd.

Dr. Hainsworth

Dr. Hainsworth joined the company in 1952, and had served since that time as technical advisor to the executive vice president. He was formerly vice president of the Engineering division for Servel, Inc., and is a past chairman of the Industrial Research Institute.

He has also served as president of the American Society of Refrigerating Engineers, and as vice chairman of the Industrial and Engineering division, National Research Council.

Lee Van Horn, formerly vice president in charge of research and development, has assumed the duties of vice president in charge of process and development.

Plans Okayed for Merging Derby Into Colorado Oil

Plans for merging Derby Oil Company into Colorado Oil & Gas Corporation have been substantially agreed upon. W. C. Norman, president of Colorado Oil, said that the purposed merger will be submitted to stockholders of the two companies shortly.

No change of policy in refining and marketing is contemplated. Derby's recently modernized refinery at Wichita, Kan., has a capacity of 15,000 barrels a day. Company's net crude oil production is about 3400 barrels a day.

Texaco Enlarges Research And Technical Activities

"Substantial expansion" of its research and technical activities has been announced by The Texas Company.

The move entailed: 1) establishment of an independent Research and Technical department, and 2) expansion of the company's research facilities at its principal research laboratory at Beacon, N. Y.

Vice President Named

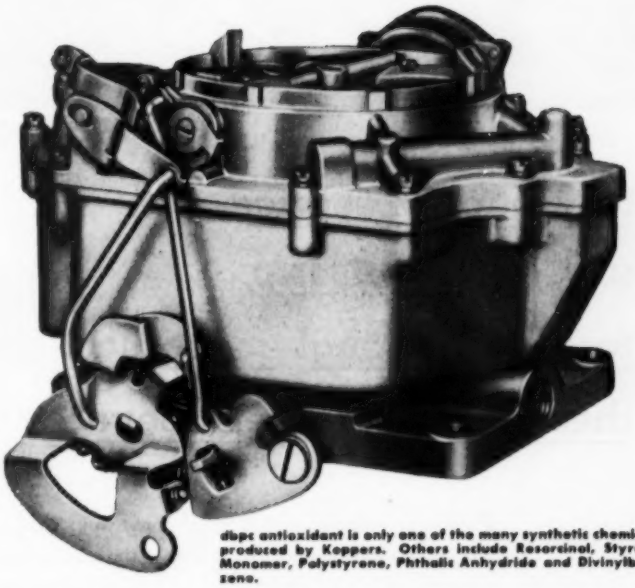
O. N. Miller, who has been general manager of the Manufacturing department of Standard Oil Company of California for the past eight years, has been appointed a vice president. He has been with the company since 1934.

Gulf to Close Refinery

The 14,000-barrel-a-day Neville Island refinery of Gulf Oil Corporation at Pittsburgh will be shut down within two months because studies show its location "does not lend itself to a program of en-

dbpc® antioxidant

Reduces the formation of fuel deposits in carburetor systems



dbpc antioxidant is only one of the many synthetic chemicals produced by Koppers. Others include Resorcinol, Styrene Monomer, Polystyrene, Phthalic Anhydride and Divinylbenzene.

● Gasoline inhibited with **dbpc** (di-tert-butyl-para-cresol) antioxidant reduces the formation of gums which are found in carburetor systems. Because of its thermal and chemical stability, **dbpc**, itself, does not contribute to intake system deposits.

In the field this gum inhibitor has been found to alleviate deposit conditions occurring in carburetor throats, manifold ports and intake valves. These factors which contribute to induction system deposits also may affect power section cleanliness.

dbpc acts as a dual-purpose antioxidant because it also retards the formation of gum in gasoline over extended storage periods.

dbpc is more economical than other gasoline antioxidants—the cost of protection being *less than a hundredth of a cent per gallon.*

dbpc can be added to the gasoline early in the refining process, since it cannot be extracted by water, caustic, clay or the commonly-used pipe line corrosion inhibitors.

Available in both a flake and liquid form, **dbpc** offers you the highest protection. It may pay you to give it a trial. For full technical information, write to us.

KOPPERS COMPANY, INC.

Chemical Division, Dept. PR-94, Pittsburgh 19, Pennsylvania

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SALES OFFICES: NEW YORK · BOSTON · PHILADELPHIA · ATLANTA
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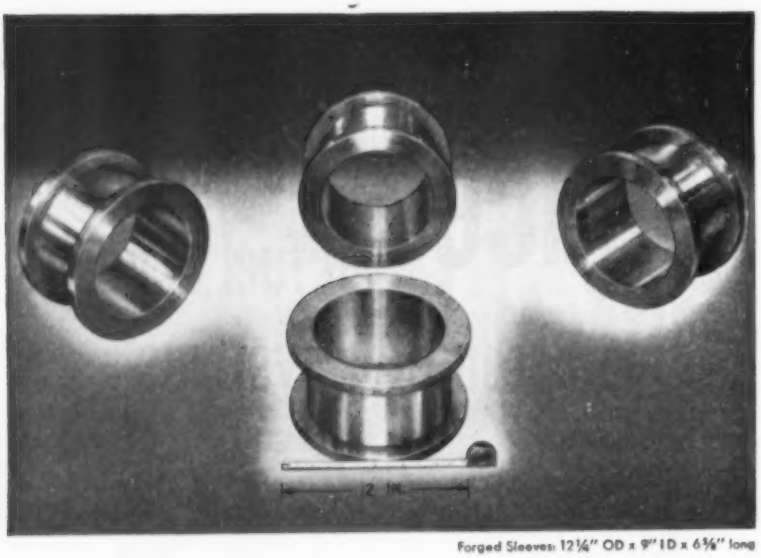


Forged Sleeves: 12¼" OD x 9" ID x 6⅝" long

for complete service

G. O. CARLSON, INC.

forged and rough machined

these stainless steel sleeves

Producing stainless steel forgings is not easy. That is why many plants turn this work over to the experienced personnel of G. O. Carlson, Inc. The forgings illustrated are special sleeves made of Type 302 stainless, formed first as rings and then rough machined in the Carlson machine shop. Products such as these forgings are made at substantial savings because Carlson's technical knowledge, practical skill and specialized equipment combine to do a faster job with less waste of valuable material.

Forgings, heads, diameters, rings, plates and other stainless steel specialties are regularly made by us to meet the most rigid chemical industry standards.

Contact G. O. Carlson, Inc. for your needs in stainless steel.

Stainless Steels Exclusively

G. O. CARLSON, INC.

Plates • Plate Products • Forgings • Bars • Sheets (No. 1 Finish)

THORNDALE, PENNSYLVANIA

District Sales Offices in Principal Cities

What's Happening. . .

largement and modernization." Recent operations have been averaging 7000 barrels a day.

Humble Sets Courses for Baytown Lecture Series

Humble Oil & Refining Company's 1954-55 "Humble Lectures in Science" program at its Baytown, Texas, refinery will include five courses to be presented by eminent college professors from the U. S. and England. This program was established in 1946 to provide additional fundamental training to help Humble technical personnel keep abreast of current developments of science.

Victor L. Streeter, formerly professor of mechanics at Illinois Institute of Technology and now at the University of Michigan, will initiate the current series with a course in fluid mechanics in September. During mid-fall R. R. White, professor of chemical engineering at the University of Michigan, will conduct a series of lectures on scale-up of processes.

The third course will be given by Professor A. D. Walsh of The University, Leeds, England. His subject will be oxidation of hydrocarbons; a similar course was given by Professor Walsh at Baytown in 1950.

In February C. R. Wylie, Jr., professor of mathematics, University of Utah, will teach two weeks; his subject is mathematics of chemical engineering. The last series, on physics and chemistry of the solid state, will be given next June by Charles Kittel, professor of physics at the University of California, Berkeley.

Each course will be of two-weeks duration.

Former Sinclair Men Die

George H. Taber, Jr., former president of Sinclair Refining Company, died last month at Rye, N. Y. He was 64.

Taber was the second former executive of Sinclair to die in August. H. H. Fuller, retired vice president of Sinclair, died earlier in the month at his home at Miami Beach, Fla. Fuller, 68, began his oil career in 1905 with The Atlantic Refining Company and joined Sinclair in 1919.

George Hanneken Dies

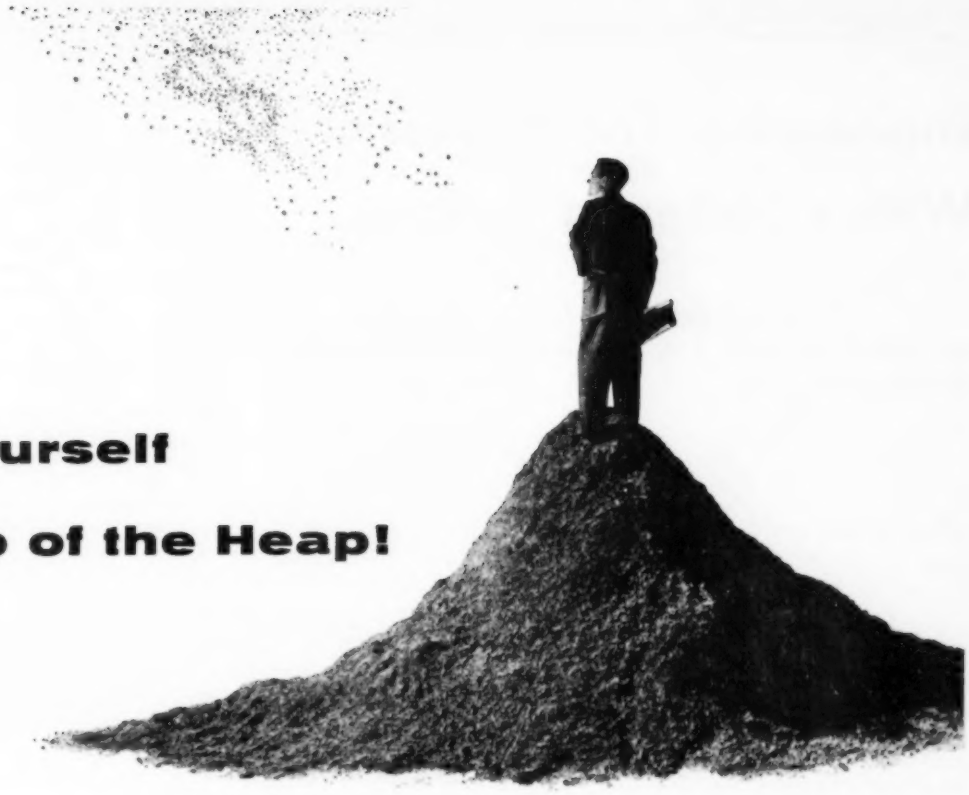
George W. Hanneken, former vice president and a director of The Standard Oil Company (Ohio), died August 17 at the age of 73.

Born in Missouri, Hanneken started as a pipe fitter helper with Standard Oil Company of Kansas at its Neodesha refinery in 1902. He joined Sohio in 1917. In 1939 he was elected vice president of Sohio and in 1940 became a director. He was retired in 1946.

Max Ball Dies at 68

Max W. Ball, who headed the Interior Department's Oil and Gas Division from 1946 through 1948, died August 28 of a heart attack. He was 68. Ball had headed his own oil consulting service since 1928.

For more data on advertised products, use Readers' Service Cards, last page.



Put Yourself on Top of the Heap!

You can collect big money simply by collecting the valuable dust that's usually wasted in your plant's operations!

How much? Buell equipment frequently collects as much as 40 tons a day. Convert that into cash and you can see what you're missing!

Buell specialists have developed three different types of dust collection equipment. The right equipment to handle *any* dust collection problem. Each is carefully tailored to meet your individual problem. Actually, each problem is different—each solution must be different to meet the many variables.

Buell equipment has set truly amazing records for efficiency . . . for low maintenance . . . for versatility. Why settle for less than the best? Write Buell Engineering Company, Dept. I-21, 70 Pine Street, New York 5, N. Y.

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MECHANICAL ELECTRICAL

20 Years of Engineered Efficiency in

DUST RECOVERY SYSTEMS

For more data on advertised products, use Readers' Service Cards, last page.

Engineering: The Profession With a Glittering Horizon

How is engineering talent being used? In 1952, about one of every four was occupied with research and development.

Part II.

Irving Ladimer and Robert W. Cain,
Washington, D.C.

III. *Distribution of Engineers*

Where are engineers and what magnets in private and public employment exert the strongest pull?

The most important recent compilation, done for the Defense department, was a survey of senior engineers, with a record of each man's education, experience, and competence and definition of engineering specialties. Results were published in "Employment, Education and Income of Engineers, 1949-50."

Roster activities have been transferred from the Office of Education to Uncle Sam's newest scientific coordinating agency, the National Science Foundation. The job of listing has been decentralized and will be handled by individual technical societies under guidance of the foundation. The Engineers Joint Council has been working with the foundation to set up a "finder list" of selected engineers who can be used to find other engineers in a national emergency. From industry studies and from these sources come and will come spread data about the professions. Latest reports show: Engineers will find employment opportunities in all of the nation's major industries, both defense and nondefense, in private industry and in government. According to a 1950 census sample, almost four out of five worked in private industry but over 90,000 of the estimated 522,000 men in engineering were government — federal and state — employes. (See Table 3.)

Many engineers work on problems involved in current production; others work in design, application and research, improving old products or methods or developing new products and processes. A sizeable group of about 50,000 today supervise construction and another 12,000 are in operation of mines. Still others are employed as independent consultants, who advise their clients on engineering matters, prepare roughs or finished plans. Engineering knowledge holds a high place in administration and management, particularly in industries in which technical methods are important, adding up to 75,000 in trade and service in 1950.

Many companies frankly employ engineers in selling their products, particularly when the buyer is a business firm or when the salesman must be able to discuss mechanics of the product and advise as to its installation and use. Teaching of engineering in colleges or technical schools absorbed another 13,000 engineers in 1950. The table does not reflect changes since Korea, but does show a drop in manufacturing and government work after World War II.

Looked at otherwise—by branch of engineering—in 1950, the great majority of mechanical, chemical, aeronautical engineers were in private industry but 2 out of 5 civil engineers were in government, mainly in state and local bridge and road building, sanitation and maintenance (Table 4).

TABLE 3
Estimated Number of Male Engineers, by Field of Employment, 1950*

Manufacturing: durable goods	176,000	
Manufacturing: non-durable goods	55,000	
Total in manufacturing		231,000
Trade, finance, and service industries	44,000	
Professional service fields	31,000	
Total in trade and service		75,000
Construction	45,000	
Utilities	25,000	
Communication	16,000	
Mining	12,000	
Transportation	11,000	
Agriculture, forestry, and fishing	1,000	
Total in private industry		415,000
Federal government	51,000	
State and local government	42,000	
Total in government		93,000
Professors and instructors	8,000	
Others in education	5,000	
Total in education		13,000
Grand Total		522,000

* Based on 1950 Census sample. Excludes about 7000 women, and others who were retired or not employed for other reasons at the time of the survey. The Engineering Manpower Commission estimates that there were 450,000 engineers in 1952 on the basis of its correction of Census data.

TABLE 4
Percentage Distribution of Engineers in Selected Branches of Engineering, by Field of Employment, 1950*

EMPLOYMENT	ENGINEERING BRANCH				
	Aeronautical	Mechanical	Civil	Electrical	Chemical
Manufacturing	80.0	62.3	9.2	35.1	76.4
Utilities	.2	3.9	4.6	15.5	2.2
Communication	.2	.8	.5	12.1	.3
Construction	.7	7.4	23.4	5.2	2.6
Transportation	3.0	2.5	3.7	2.0	.2
Mining		1.3	1.1	.9	2.5
Other industries	3.2	16.4	14.1	20.7	12.5
Government	12.7	5.4	43.4	8.5	3.3
Total	100.0	100.0	100.0	100.0	100.0

* Based on 1950 Census sample.

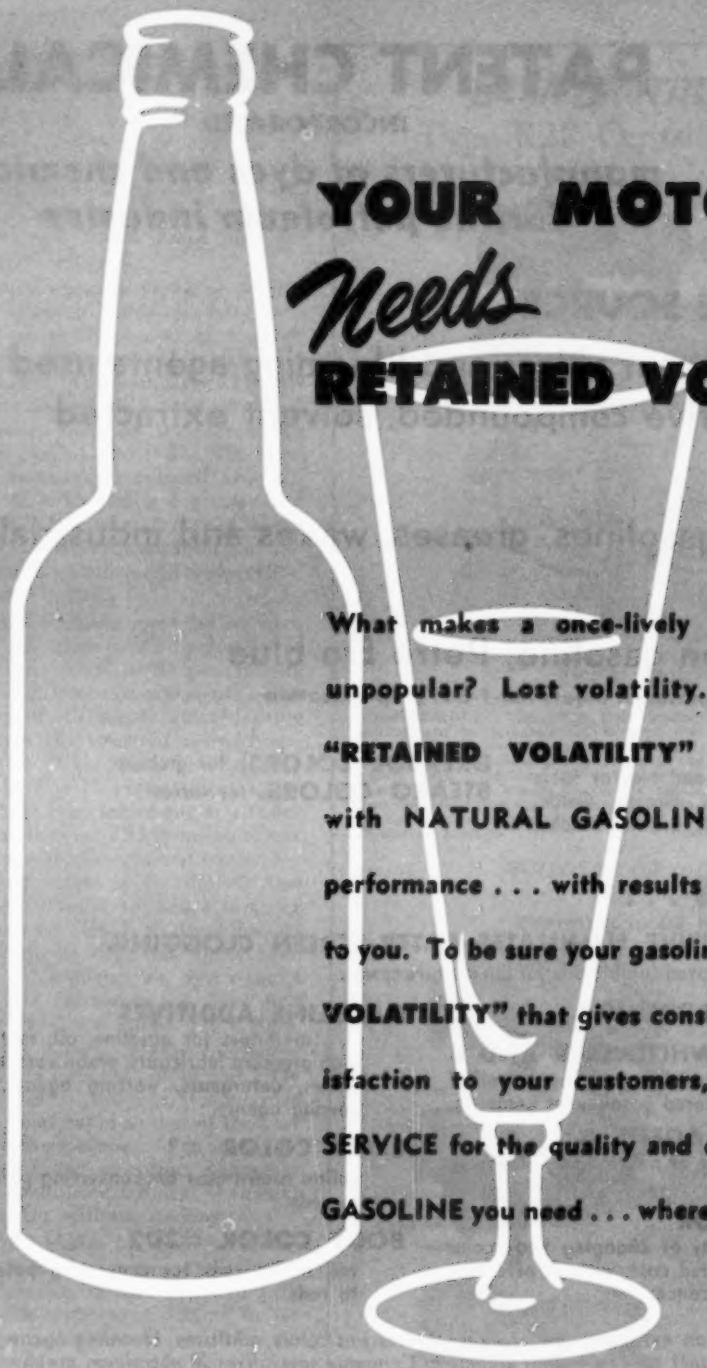
Tables 3 and 4 from Chapter 8, "A Policy for Scientific and Professional Manpower", National Manpower Council, Columbia University Press, 1953.

IV. *Research and Development*

Research is a vital and significant part of our national output and manpower — particularly technical manpower. In 1952, about 130,000 engineers and scientists—one fourth of all our technical manpower—were in research and development. The nation's bill for searching out scientific knowledge was about $3.75 billion, more than 1 percent of our gross national product, which is the market value of the output of all goods and services.

The money came from three principal sources—the federal government, industry, and non-profit institutions. The federal government financed about 60 percent of the total or $2240 million, industry 38 percent or $1430 million, and non-profit institutions, mainly colleges and universities, paid for the remainder.

Government's Role—Almost half of all research done by industry was for the federal government. The aircraft industry, with about 85 percent of its research supported by federal money, is the outstanding example of industry research for government. The electrical machinery and the professional and scitntific instruments also received well over half their research funds from Uncle Sam. But, interestingly, the government footed the bill for only 3 percent of the research in



YOUR MOTOR FUEL *Needs* RETAINED VOLATILITY *too!*

What makes a once-lively drink stale, flat and unpopular? Lost volatility. Motor fuel without "RETAINED VOLATILITY" gained by blending with NATURAL GASOLINE soon goes flat in performance . . . with results definitely unprofitable to you. To be sure your gasoline has the "RETAINED VOLATILITY" that gives consistent and uniform satisfaction to your customers, rely on WARREN'S SERVICE for the quality and quantity of NATURAL GASOLINE you need . . . where and when you want it.

WARREN

PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

PATENT CHEMICALS

INCORPORATED

manufacturers of dyes and chemicals for the petroleum industry

YOUR DEPENDABLE SOURCE . . .

- for fluorescent colors and blooming agents used with additive compounded, solvent extracted lube oils
- dyes for gasolines, greases, waxes and industrial products
- for aviation gasoline, Petro Ero blue

This material meets Mil-F-5572 Specification

"PETROL" COLORS
for gasoline, kerosene, diesel and tractor fuels . . . Bronzes, Ambers, Blues, Greens, Golds, Yellows, Purples, Oranges, Reds, Browns, Blacks.

GREASOL COLORS, for greases
STEARO COLORS, for waxes

SPECIAL PRODUCTS . . .

FUEL OIL ADDITIVE ELIMINATES FILTER-SCREEN CLOGGING
Mulsor for improved soluble oils for agriculture sprays

TURBINE OIL ADDITIVES

PETROL BLUE WHITENER R AND B
are used to neutralize undesirable yellow shades in uncolored gasoline or kerosene.

DEBLOOMING AGENT A
has the property of neutralizing blooms in lubricating oils.

N. P. A. COLOR
has the property of changing body color of pale oils to red cast, without affecting natural fluorescence.

GASOLINE ADDITIVES
. . . inhibitors for gasoline, oil, rust . . . high pressure lubricants, stabilizers, emulsifiers, detergents, wetting agents, dispersing agents.

BODY COLOR #1
yellow brown cast for converting pale oils to reds.

BODY COLOR #302
red brown cast for converting pale oils to reds.

In addition to an extensive line of dyes, fluorescent colors, additives, blooming agents, etc., the technical staff of The Patent Chemical Company specializes in petroleum problems and is available for the study and preparation of particular products to meet special requirements involving dyes; fluorescent colors; additives; blooming, wetting, dispersion agents, etc.

for complete details write or phone

PATENT CHEMICALS, INC.

PATENT PC CHEMICALS

PATENT FUELS & COLOR CORPORATION
MARKETING DIVISION
2410 Carew Tower
Cincinnati 2, Ohio

PATENT CHEMICALS INCORPORATED
MANUFACTURING DIVISION
335 McLean Boulevard
Paterson 4, New Jersey

pioneers in gasoline colors • petroleum additives

petroleum refining and 7 percent in chemicals. By doing some of the research work required by the government without reimbursement, however, these industries participate in defense research to a larger extent than the percentages indicate.

Industry, while supplying 38 percent of all research funds, actually performed about 68 percent of research and development, mostly for the federal government. Approximately 118,000 engineers and scientists were employed in research alone by industry at an average cost of about $22,000. Nonprofit institutions employed approximately 29,000 research engineers and scientists at an average cost of about $15,000, and government itself had 33,000 research scientists and engineers on the payroll in 1952.

The $3.75 billion spent for research in 1952 was more than 10 percent over the previous year—a 30 percent rise since Korea. This rise represents a continuation of the steady upward surge which has characterized research activity since 1941. Since the beginning of World War II, expenditures on research have been increasing at a faster pace than the over-all expansion of our economy, with allowance, of course, for decreasing values in the dollar. Also weapons are more and more complex and expensive. The B-36 which had its initial flight in 1946 cost about $126 million to develop; the development cost of its successor, the B-52 first flown in 1952, was almost $70 million.

It seems definite that an increasing share of our national output will go to research. Likely, however, this increase will not be as rapid as that of the past decade because of the limited supply of engineering and scientific manpower and the possible curtailment of federal spending for military research.

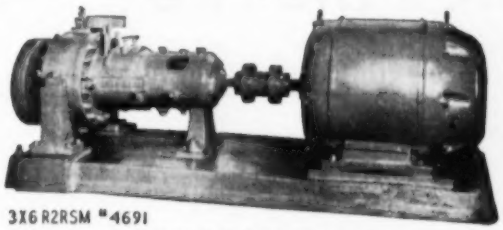
If world affairs become less turbulent, the federal government will doubtless reduce its military research program, with consequent decline in research until the effort released can be converted to civilian needs. But the tremendous commercial possibilities of atomic energy and expanding requirements of a growing economy should shorten the lag between any military cutback and commercial expansion.

In the long run, however, research depends upon the number of engineers and scientists available. In the next several years, the small number of engineering and scientific graduates will probably not permit any large scale expansion.

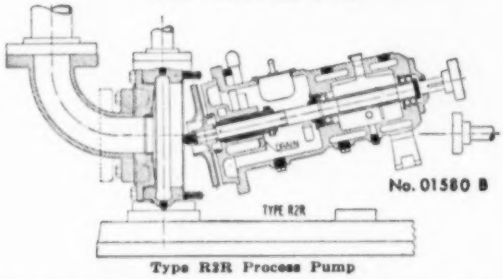
End of Part II and series.

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

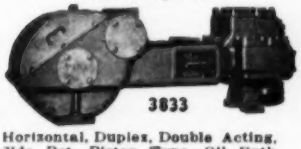
BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

Close Coupled Centrifugal Pump

3510
Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids

Pedestal Mounted Centrifugal Pump



3833
Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump

4728
Double Pedestal Bearing Centrifugal Pump

3556
Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

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Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

For more data on advertised products, use Readers' Service Cards, last page.

AS Management Sees It . . .

Where's the Fire?

Fire extinguishment in oil processing, storage and transport facilities.

Part VII

H. B. Williams, Director, Safety and Fire Protection,
Pan American Refining Corporation,
Texas City, Texas

Agitators, Internal Fire

1. Trip all explosion doors to exclude air from the fire.
2. Apply steam through the agitator snuffling ring.
3. Apply water to the roof through the roof spray ring.
4. Use water spray from hose streams as required to provide maximum cooling of the structure.

Agitators, Bottom Assembly Fire

1. Combat fire with high pressure water fog or dry powder.
2. Apply cooling water streams to structural members, pipe assembly and agitator shell. Apply water to the roof through the roof spray ring.

Tank Trucks Cargo Fires

Butane-Propane: Extinguish only by eliminating the fuel source. Gasoline: Extinguish with dry powder from the 150-pound engines.

1. Stop all pumping operations.
2. Close block valves in lines to refinery tanks.
3. Apply cooling water spray from 2½-inch hose lines to blanket the truck tanks completely. Cooling streams should be maintained after flame extinguishment until all danger of reignition from hot steel has been eliminated.
4. Protect adjacent refinery equipment and other tank trucks with cooling water streams.
5. If control valves on the tank truck are operable, shut off the supply of fuel to extinguish the flames. If this is not practicable, permit butane or propane to burn out under controlled conditions. Extinguish gasoline fire with dry powder.

Railroad Tank Cars—Butane—All Fires

1. Stop all loading and unloading operations at unaffected spots.
2. Remove the spouts and close the domes of all unaffected cars.
3. If a pressure fire burning at the dome *does not endanger* the gas pressurizing hose line, continue pump-out operations to reduce the volume of flammable materials. If there is danger of the gas pressurizing hose burning, shut off the gas and continue pumping out until the pump loses suction.
4. Apply cooling water spray from 2½-inch hose lines to the burning car and adjacent cars.
5. Remove unaffected tank cars from the fire area if possible.
6. Do not extinguish the flames except by fuel elimination as described below, unless extinguishment can be followed immediately by fuel shut off to avoid drifting vapors.
7. If controls on the car are operable, working under water-fog protection, close valves to stop the flow of vapor. Should it be advisable to first extinguish the flame, dry powder should be used. If this latter procedure is to be attempted, preparations should be made in advance for reignition of the vapors should it be impossible to stop the vapor flow. In such an event permit a complete burnout under controlled conditions.

Railroad Tank Cars—Products Other Than Butane—All Fires

1. Stop all loading and unloading operations at the racks.
2. Remove the spouts and close the domes of all unaffected cars.
3. Apply cooling water spray from 2½-inch hose lines to the tank of the burning car and adjacent cars. Avoid directing water streams into the dome of the burning car. This might increase the intensity of the fire by splashing flammable material, floating flammable material out of the tank or causing it to froth and slop or boil over.
4. Remove unaffected tank cars from the fire area if possible.
5. Use dry powder from the 150-pound engine to extinguish the fire.
6. If a *tetra ethyl lead fluid* (not leaded gasoline) car is involved, *avoid breathing the smoke from the fire.*

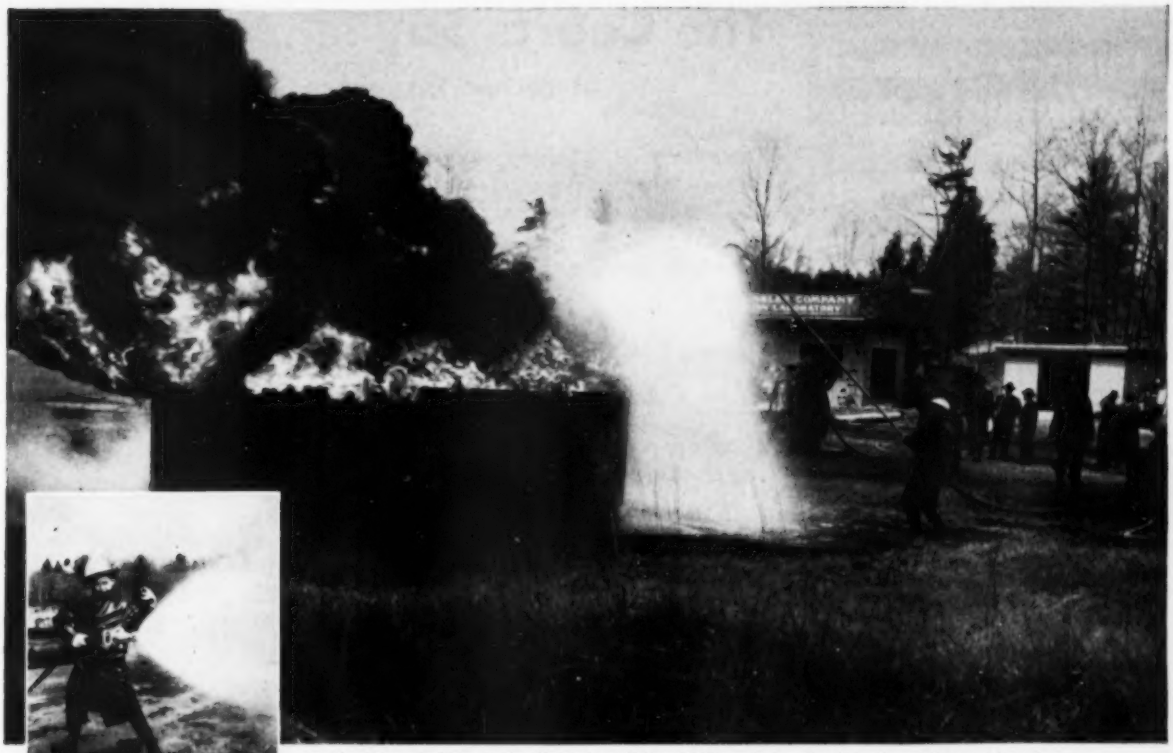
Barges and Tankers, Cargo Fires

1. Stop all transfer of products.
2. Apply cooling water streams to deck and sides of vessel.
3. Extinguish fires at hatches by closing the cover plates under high pressure water fog protection.
4. Extinguish fires at vents or manifolds with high pressure water fog or dry powder extinguishers.
5. If tank seams have been opened by explosion, apply chemical foam through the opening with generator and deluge equipment.
6. Protect terminal facilities with the installed water spray system, the monitor nozzles and additional hose streams if necessary.
7. Spread of oil that may be spilled into harbor waters should be controlled by use of the "spill boom" situation on No. 1 dock.

Process Unit Fires—General Notes

Process unit fires are extinguished principally by fuel removal. This depends upon operational changes to reduce pressure, introduce steam to systems and blowing down sections or all of the unit involved.

The area and intensity of a fire will indicate the proper method of extinguishment. Small fires can be combatted with dry powder chemical, CO_2 or steam. Foam should be used only where it can blanket the burning fuel. Water in the form of spray or high-pressure fog is most effective on large area or intense fires that threaten damage to supporting structures and adjacent equipment. The use of water, however, may cause flanges and joints to leak, thereby adding to the fire. Adjusting the water stream to spray or fog will lessen this danger.



One Hand Operation! Easy-to-handle Rockwood WaterFOG nozzle is made of aluminum alloy, weighs only 5 pounds, 5 ounces. Nozzle design reduces reaction to a minimum.

Boy puts out raging fire

The fuel oil test fire above was extinguished in a matter of seconds by a 12-year-old boy — thanks to remarkable Rockwood firefighting equipment.

By using a lightweight, 10-foot applicator, he was able to approach the fire safely as low velocity Rockwood WaterFOG was discharged through the applicator, quenching flames, choking off oxygen and cooling the surrounding area thus preventing "flash back."

Rockwood WaterFOG is the result of discharging water through a specially engineered Rockwood nozzle that breaks water into tiny particles which burst into a blanketing mist of steam that smothers fire. The Nozzle shown in use here is a 1½" Type SG 48. It can also discharge high velocity WaterFOG, and straight water stream. Available for ¾", 1", 1½" and 2½" fire hose sizes.

Plan to make this and other Rockwood firefighting aids part of your team.

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

Rockwood Double Strength Foam Liquid, 3 parts mixed with 97 parts water, forms a quickly re-sealing, solid FOAM blanket or a highly heat absorbent FogFOAM pattern — depending on the Rockwood equipment used to discharge it. Available in 5-gallon cans or 50-gallon drums.

Rockwood Wet, 1 part mixed with 99 parts water, increases penetration and extinguishing action of water. Excellent where fire is deep seated or where water is scarce. Helps reduce amount of time and manpower required. Available in 5-gallon cans or 50-gallon drums.

SEND FOR THIS INFORMATIVE BOOKLET

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
389 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire-fighting products.

Name.....

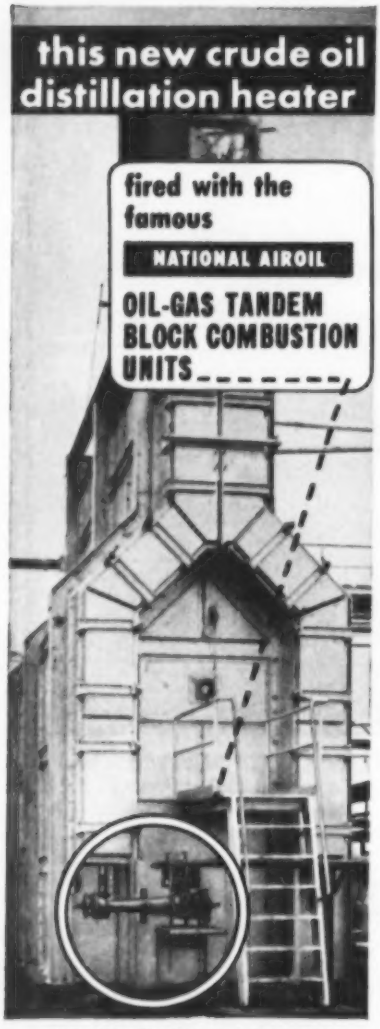
Title.....

Company.....

Street..... City.....

Zone..... State.....

For more data on advertised products, use Readers' Service Cards, last page.



...MEANS MANY MORE HOURS ON STREAM WITHOUT SHUTDOWN

This heater (RJ Oil & Refining Co., Inc., Princeton, Indiana) is fired from each end with one of NATIONAL AIROIL's #2 combination oil and gas, patented, Tandem Block Combustion Units.

The Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame . . . maintains required temperature using either fuel . . . radiates heat uniformly without tube impingement. With the Tandem Unit's clean flame, a cold furnace can be brought to full capacity in a shorter time.

You will realize more satisfaction from YOUR heaters when NATIONAL AIROIL Tandem Combustion Units are specified.

CHEMICAL PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

1254 East Sedgley Ave., Philadelphia 34, Pa.
Southwestern Division: 2512 So. Blvd., Houston 6, Tex.

The Courts Say . . .

in recent insurance cases

Shelton

This column is to inform—not advise. It presents the current trend in legal thinking on insurance cases. The law varies from state to state and its application depends upon the facts of the particular case. Do not attempt to apply it without consulting your attorney.

By Joseph M. Shelton, Attorney at Law, Dallas

That employe asked for job after trial was not conclusive on issue of disability

EMPLOYE SUFFERED an injury and claimed total and permanent disability. Upon trial before a jury employe was found to have been so disabled. A few days after the trial employe approached a third party and asked for a job. It was said that the employe indicated he was ready, willing and able to go to work and wanted a job. Insurance company asked for a new trial on the basis of this newly discovered evidence. The Trial Court denied a new trial.

The Texas Court of Civil Appeals said the fact that employe asked for a job is not conclusive that he was not totally and permanently disabled. The fact that a worker is compelled by the spur of necessity after injury is not conclusive on the issue. The court felt that the opinion testimony of the third party merely impeached the testimony given by employe or trial and did afford grounds for a new trial.

—Texas Employers' Ins. Assn. v. Pillow
268 S. W. 2d 716 (Tex. Civ. App.—Fort Worth, 1954)

That employe injured while playing softball was not entitled to compensation

EMPLOYE received an injury to his left foot as a result of an accident while playing on a soft-ball team composed of employes. The team played in an industrial league and its entrance fee was paid by the employer, who also paid for some equipment, including jerseys with employer's name on them. The team practiced and played its game after work hours. Games were played in public parks. The players furnished their own transportation to and from games. No pay was received and no official of the company asked the employe to play. Publicity about the team and games was carried in the company newspaper. Trial examiner awarded compensation to employe. The full Industrial Commission reversed the decision and denied employe's claim. He appealed.

The Missouri Court said the relationship of master and servant must exist. The essential element is the right of the employer to control the means and manner of the service to be rendered. Here the company had no right to supervise, control or direct the activities of the ball players, and made no effort to appropriate such right.

The relationship of master and servant temporarily ceased during the time of the ball games. The employe argued the broad sociological viewpoint of benefit to the employer in better employe-employer relationship, which the court felt was beyond the plain wording of the compensation statute. It said the compensation law was never intended to operate as accident insurance covering all injuries wherever and whenever received by the employe.

—McFarland v. St. Louis Car Co.
262 SW 2d 344 (St. Louis Ct. of App. Mo., 1953)

For more data on advertised products, use Readers' Service Cards, last page.

BEAIRD-INGERSOLL-RAND
Packaged Compressor Plant

Lowest Cost Per Horsepower Installed

Triples Production—

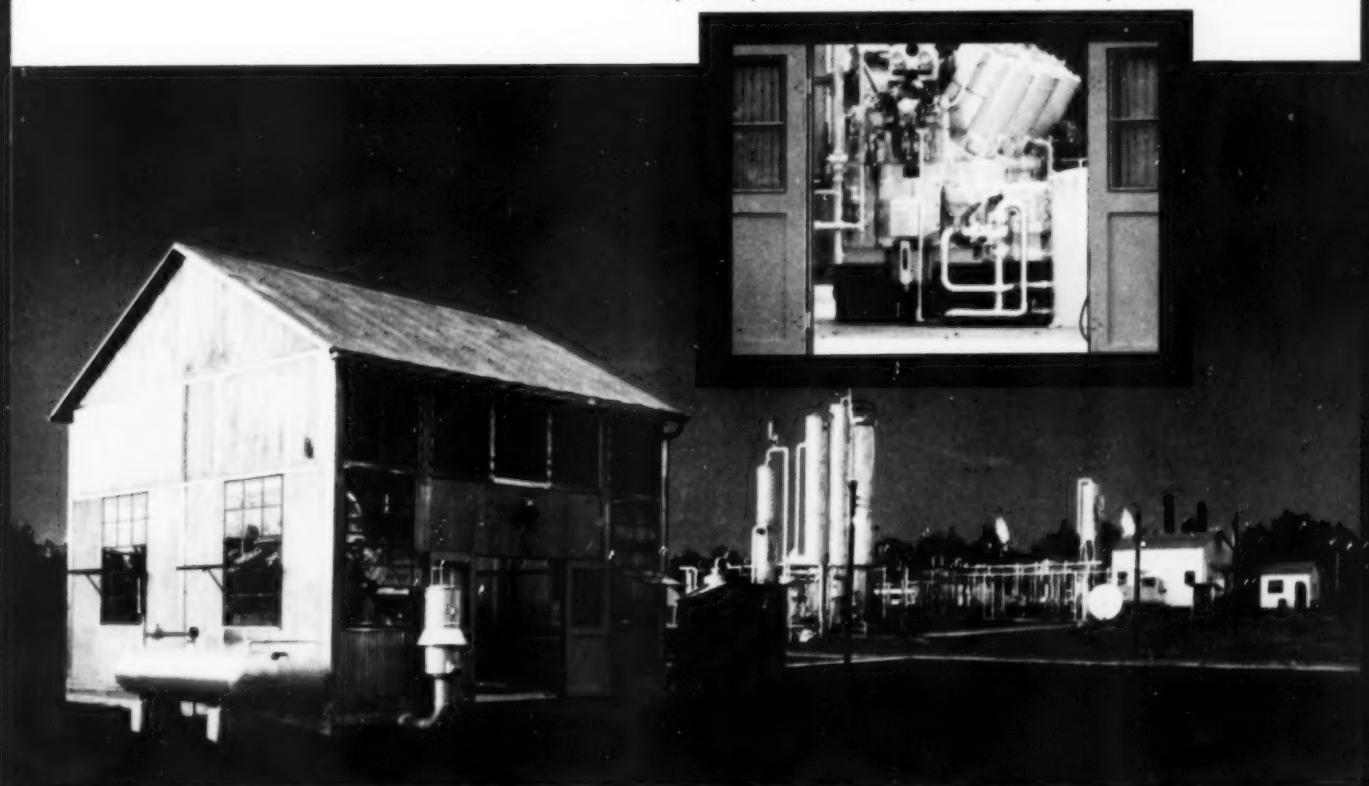
PACKAGED COMPRESSOR MAKES FLEXIBLE INSTALLATION

ARKANSAS LOUISIANA GAS COMPANY had seven wells in the Rodessa Field where wellhead pressures had dropped below the pressure of the gathering lines. Formerly good producers, the wells still contained profitable reserves that could be recovered by lowering gathering line pressure. To put the wells back into production economically, a 330 h.p. Beaird-Ingersoll-Rand Packaged Compressor Unit was installed at the Smithland, Texas, gasoline plant. Lowering pressure on the field line and boosting the gas through the plant and into the sales line, the unit tripled production from the wells.

Anticipating a relatively short life for the field, Arkansas Louisiana Gas specified that Beaird design the unit to meet a wide range of operating conditions. The flexibility of this design will permit the unit to be moved without change, to other service. Completely assembled and mounted on its own steel base it required a minimum in the way of permanent foundation and connecting piping. This feature makes the installation almost wholly salvageable when moved.

Pioneers and leaders in the development of packaged compressor plants — Beaird offers you proven equipment with an outstanding record of successful operation over a wide range of service.

Let us show you how a Beaird-Ingersoll-Rand packaged compressor plant can be designed to meet your requirements.



Arkansas-Louisiana-Gas Company's Smithland, Texas, packaged compressor plant — equipped with an Ingersoll-Rand 330 h.p. 6SVG gas engine driven compressor, Young radiator and all necessary equipment and controls. Other sizes 110 h.p. to 660 h.p. The steel deck has been mounted flush with the flooring at the option of the purchaser.

THE J. B. BEAIRD COMPANY, INC.
Shreveport, Louisiana

BEAIRD

MACHINING MANUFACTURING STEEL WAREHOUSE

PACKAGED COMPRESSOR PLANTS

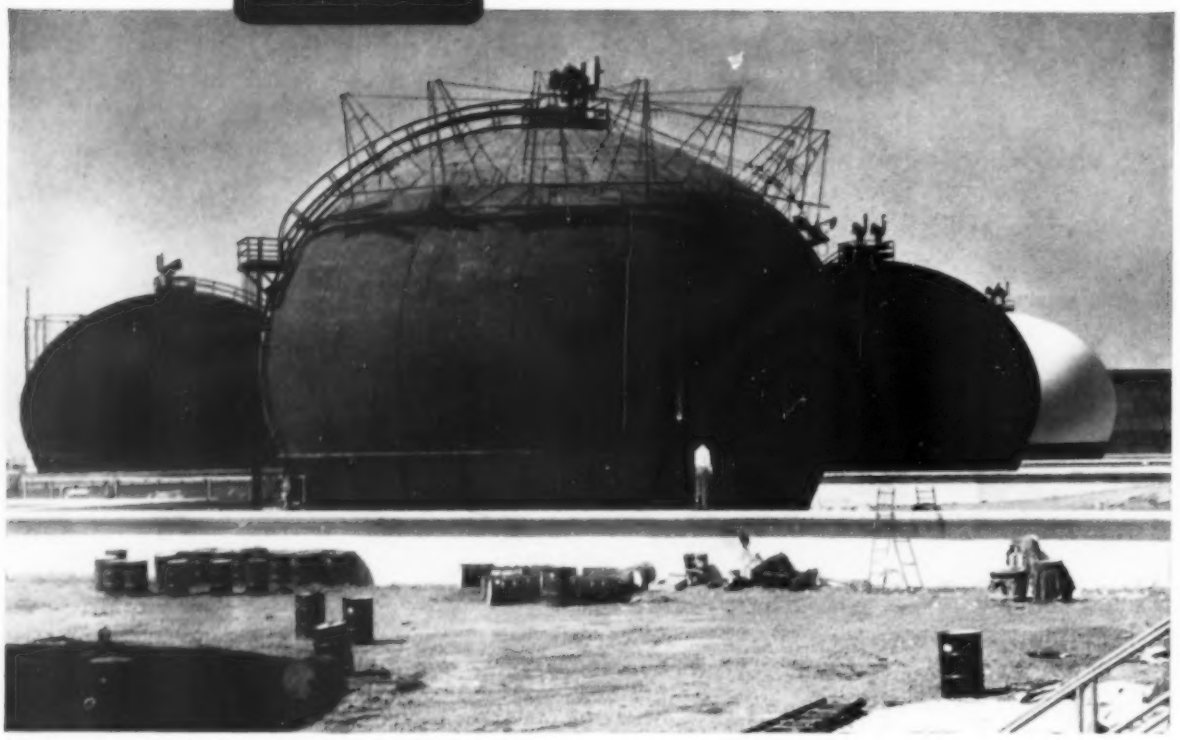
CAST STEEL FITTINGS

PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP-GAS SYSTEMS

ANOTHER **ERKOTE** APPLICATION OF MASTIC COATING



40,000 barrel capacity Butane storage spheroids

An insulating coating that stretches your savings....

ERKOTE® Mastic is elastic!

Ordinary rigid-type insulation soon cracks, chips and peels on surfaces that expand and contract under thermal cycling. Erkote 3X Insulating Mastic is *flexible* . . . provides a permanent insulating and protective coating that is resilient under the most severe thermal changes and weather conditions.

It is sprayed on in one seamless application and adheres to almost any type of surface. It requires no mechanical means to hold it in place, regardless of surface angle; it sheds water and is extremely resistant to chemicals and corrosive fumes. Its perfect bonding properties offer a maintenance-free coating that protects your investment in costly operating equipment year after year!

Where reflection of light and heat is desirable, Erkote 3X Insulating Mastic is applied and covered with Erkote Finisher which is available in white and a wide range of colors.

"3-in-1 protection" makes every job *our responsibility*

Since we develop and produce our own mastics and paints and furnish our own trained crews to apply and maintain Erkote products, we assume *full responsibility* for the quality of the materials and the workmanship on every job we undertake. Development . . . manufacture . . . application . . . you get *all three* from *one reliable source!*

Earl Paint Corporation • 240 Genesee Street • Utica, N.Y.

Sales Offices: Houston, Philadelphia, Baltimore, Pensacola

see our catalog in S PLANT ENGINEERING FILE or write for copy

ERKOTE TECHNICAL COATINGS — *FOR USE WHERE PAINTS FAIL*

ERKOTE PRODUCTS

Corrosion Resisting Mastics, Mica Mastics, Insulating Mastics, Vapor Seals, Troweling Mastics, Color Finishers, Industrial Paints and Varnishes.

RUMORS—

Continued from Page 108

attitude around here. It creates ill feeling and interferes with getting the work done. If this continues, we'll have to take action."

The plain fact is, malice and evil intentions can't be permitted to flourish on the job. Too much is at stake. You won't ever want to act in haste or anger. But don't forget you have at your disposal disciplinary tools, from a stern rebuke right up to a dismissal.

Are You to Blame?—Investigation has repeatedly proved one outstanding fact: "Rumors are a substitute for news."

A rumor is often an answer to a question that springs up in the public's mind. As one study of rumors in a prison camp showed, the less news, the more rumors.

Rumors rule in an atmosphere of misinformation or the lack of information. The best method for nailing a rumor is not to let it happen in the first place, to have your people so well informed that they themselves are able to separate the truth from the lie.

Your Long-Range Policy—To put the chill on the sour grapevine calls for two-way communications—from you to your people, from your group back to you.

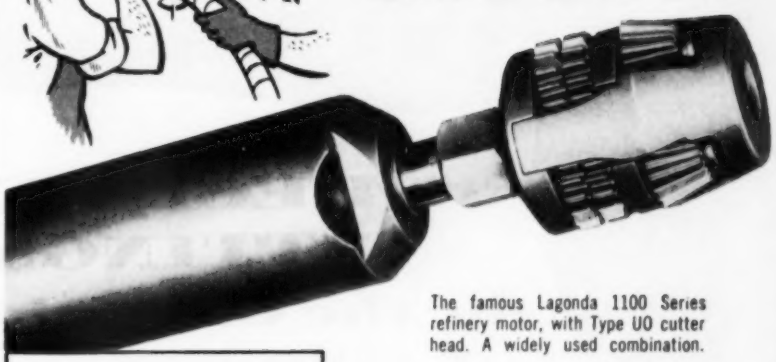
Specific communications procedures and contacts like these help make your organization rumor-free:

- Give your people advance notice of any contemplated changes whenever possible. This effort should be carried right down to the department level. Your supervisors, for example, often carry out routine changes. These too should be preceded by an announcement or explanation to departmental personnel.
- Keep your people informed of progress—company sales, finances, expansions, new products, and so on, as much as possible.
- Encourage your people to bring their questions to their superiors. This brings with it a double dividend: any free-floating rumors will reach you or other staff members at the same time it circulates in the group.

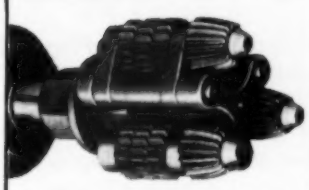
Finally, remember that the strongest—or weakest—link in the chain is the individual. The employe who's well informed, who has reason to trust you, and knows he can depend on you for the facts, is practically immune to the deadly germ. He's your strongest bulwark against ruin by rumor.

When coke is stubborn—

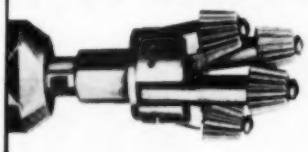
...TRY LAGONDA



The famous Lagonda 1100 Series refinery motor, with Type UO cutter head. A widely used combination.

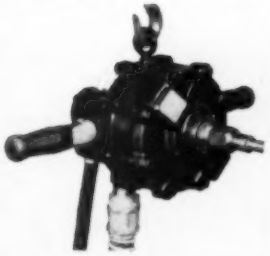


For tubes of wide tolerance – the Long-Surface Swing Frame head.



For tough, uneven coke – the Type H-2 head.

FOR CONDENSERS AND HEAT EXCHANGERS



Direct-drive air or steam driven cleaner with long shaft, the motor supported outside the tube by overhead pipe. Motor has trigger control. Also available with electric motor.

Occasionally you run into a brand of coke that laughs at everything you've got in cleaning equipment. Something different is indicated, and often that something is a change to Lagonda 1100 Series cleaners armed with a tough-slugging Lagonda head selected on the basis of Lagonda "know-how"—usually a pretty successful combination, and certainly worth trying when the time-out bill is climbing.

Lagonda cleaners have been on the job ever since the first still started up, and Lagonda engineers are veterans of many a tough coke battle. This experience is at your service. Phone your local Lagonda man, or write Elliott Company, Springfield, Ohio. Try Lagonda—it may well be the right answer.

ELLIOTT Company

Y4-3

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

For more data on advertised products, use Readers' Service Cards, last page.

PRECISION FITTINGS

for the Oil Industry

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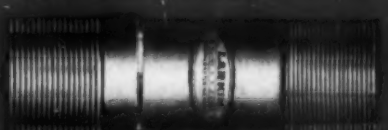

COLLEGE RECRUITING

Continued from Page 106

a personnel man from the area in which the team is working, and usually an operating manager in whose department vacancies exist.

Q. *How does the team operate in interviewing the students?*

A. First of all, the recruiting team does not hire an applicant on the spot. The team screens candidates in view of the job openings available and then recommends the best candidates to the various department managers where vacancies exist. After the screening interview which, incidentally, averages about 30 minutes, the successful candidates are asked by letter, normally within 10 days to two weeks, to go see a particular department head at com-

APPLICANT APPRAISAL

Here is the score card Paul W. Boynton keeps to help him size up a job candidate:

1. **Appearance and Health**
   - A. General Impression
   - B. Age
   - C. Physique
   - D. Hygiene
   - E. Physical Soundness
2. **Personal Attributes**
   - A. Voice
   - B. Speech Characteristics
   - C. Responsiveness
   - D. Maturity
   - E. Self-Confidence
   - F. Temperament
   - G. Social Acceptability
   - H. Attitudes
3. **Mental Alertness**
   - A. Scholastic Record—Activities
   - B. Type of Mind
   - C. Comprehension
   - D. Perseverance
   - E. Expression
   - F. Intellectual Curiosity
4. **Personal Interest**
   - A. High School and College
   - B. Community Activities
   - C. Hobbies
5. **Job and Career Interests**
   - A. Immediate Job Interests
   - B. Career Interests
   - C. Prospects of Career Realization
6. **Experience and Skills**
   - A. Education
   - B. Nature of Previous Jobs
   - C. Military Experience
   - D. Skills
7. **Work Habits**
   - A. Planning
   - B. Application
   - C. Cooperation

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Because of their horizontal design CAL-FIN tank heaters remain completely submerged even when the fluid level of the tank is down as low as 36 inches. This results in greatly improved efficiency because the residue film that tends to bake on heating surfaces which are alternately submerged and exposed, is eliminated.

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CAL-FIN TANK HEATERS are available in 20 standard sizes up to 1,325 sq. ft. Special sizes up to 6,000 sq. ft.

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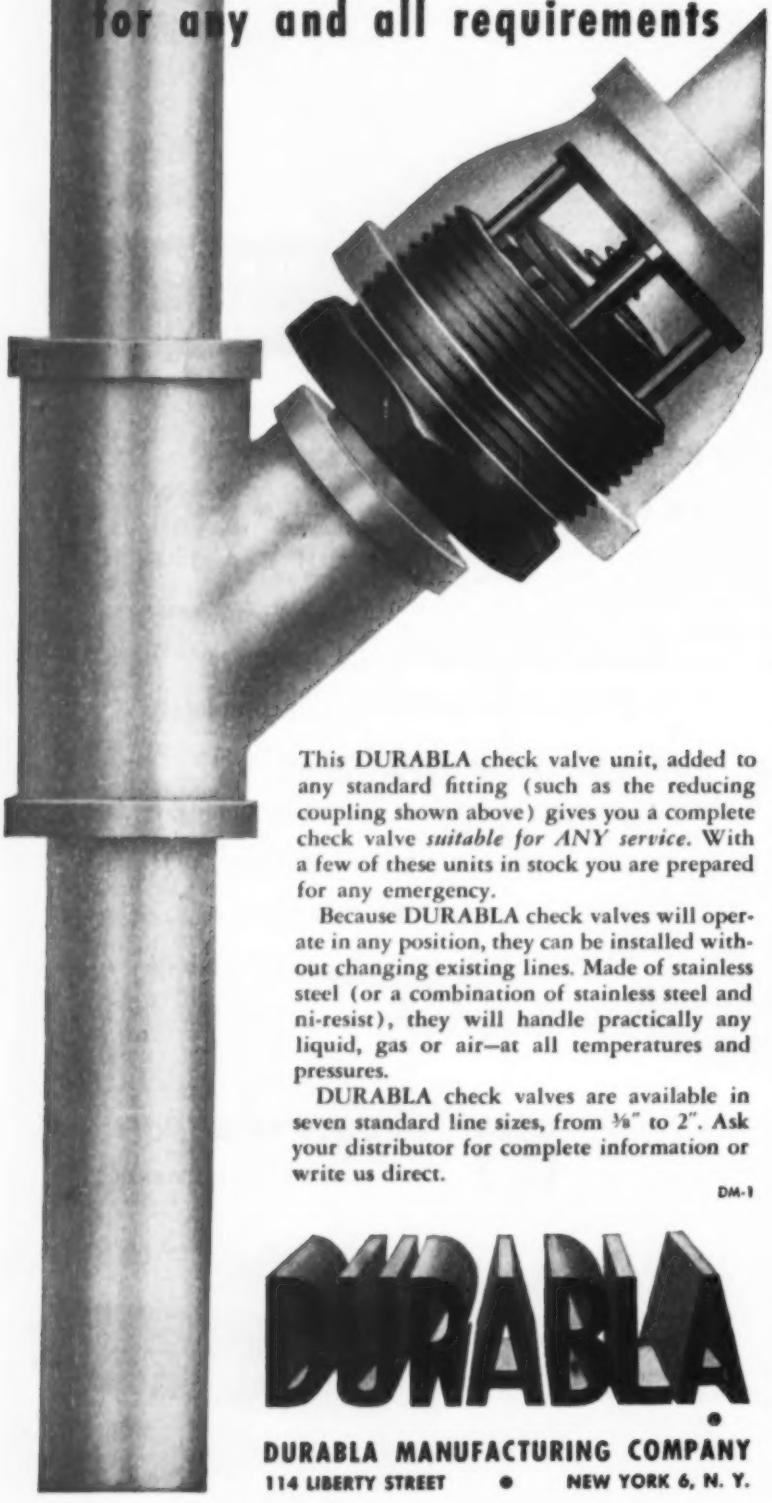
ONE CHECK VALVE

for any and all requirements



This DURABLA check valve unit, added to any standard fitting (such as the reducing coupling shown above) gives you a complete check valve *suitable for ANY service.* With a few of these units in stock you are prepared for any emergency.

Because DURABLA check valves will operate in any position, they can be installed without changing existing lines. Made of stainless steel (or a combination of stainless steel and ni-resist), they will handle practically any liquid, gas or air—at all temperatures and pressures.

DURABLA check valves are available in seven standard line sizes, from ⅜" to 2". Ask your distributor for complete information or write us direct.

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As Management Sees It . . .

pany expense for a final interview. This gives an applicant a chance to learn something of the company and to see some of the people who may be his fellow workers. Also, it gives the company a better opportunity to size up the applicant. If the department head is satisfied, he then offers the student a job.

Q. *How do you determine if the recruiters are doing a proper job, that is, selecting the candidates that are best suited for the company?*

A. The only measure of our success is in the number of candidates that are actually hired by the company from those recommended. So far we've had about 90 percent of the recommended candidates hired by department managers.

Q. *How does a recruiter go about conducting a good interview?*

A. The recruiter to be a success should put himself in the candidate's shoes and remember the problems he faced in applying for a job. Then, too, a recruiter cannot expect the applicant to be able to state every reason why he should be hired. This must be drawn out by questions. In order to get those answers, a good interviewer should first make sure the job applicant feels at east. Next, the interviewer should determine the applicant's interests, and once his interests are established, the candidate will usually tell the interviewer all he needs to know. The candidate will either sell himself or hang himself by what he says.

Q. *Mr. Boynton, as a result of your long experience in selecting personnel, what advice can you offer job applicants?*

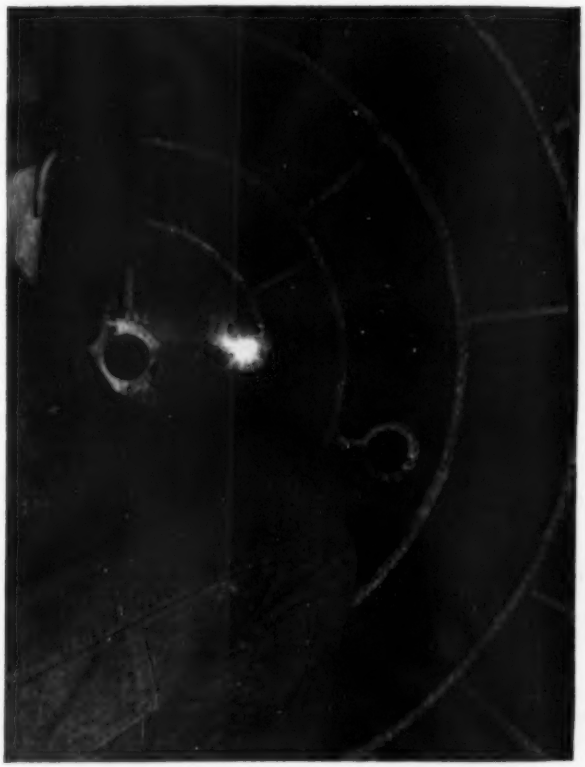
A. First, a man must want to work for a living. Secondly, he will only succeed to the extent of his abilities to sell himself . . . that is, a man should find the right job opportunity commensurate with his abilities and then sell the prospective employer that he is the best man for that job.

A job candidate should never rely on pull of friends or business associates in getting a job . . . it is proper to get a friend in a company to introduce the candidate to a department head or personnel manager, provided that after the introduction the candidate will stand on his own feet.

A job candidate is better off if he has a specific job in mind when applying to a company . . . the man willing to work at any job is a poor risk.

If it is not possible for the applicant to state a specific job, he should narrow his job interest to a specific field.

How To Solve Corrosion Problems



PROBLEM: Protecting a preheater from corrosive attack during periodic contact with hydrochloric acid, trichlor benzene, and other chlorine compounds at 300 deg. F.

REMEDY: Complete lining with HASTELLOY alloy C 11-gage sheet.

RESULT: The vessel has given four years' service and is still going strong.

PROBLEM: Valving sulphur-laden flue gas at 800 deg. F. and 300 psi.

REMEDY: A ⅛-in. layer of HASTELLOY alloy B was applied to seats and seating surfaces.

RESULT: The valves gave over four years' service despite the corrosive conditions.

Free: Money-saving jobs like these are described in detail in the monthly magazine HAYNES ALLOYS DIGEST. To receive a copy regularly, write Editor, HAYNES ALLOYS DIGEST, Room 308, 30 East 42nd Street, New York 17, New York.

HASTELLOY *alloys*

Trade-Mark

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe, cast pipe and pipe fittings, sand and precision-investment castings.

"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

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As Management Sees It . . .

The New Tax Law— Challenge to Business

New revenue code is of concern to every taxpayer, a challenge to every business. Here are some tips on how to utilize it to the best advantage.

Part I.

James B. Kobak, CPA,
Partner J. K. Lasser & Company

FOR THE FIRST time in almost 75 years, the United States has a brand-new tax law.

It is of great concern to every taxpayer. It is a challenge to every business—a challenge to exercise a new economic freedom.

There are hundreds of new benefits. Congress went through the old law with a fine-tooth comb in its drive to soften or get rid of those provisions that might stymie business growth. All that can be done here is to point out some of those benefits, and suggest you talk to your tax adviser, bearing in mind these two important goals:

• How to get the best tax break out of the law for your business.

• How to use its provisions to bolster employe morale.

Here are some of the important things you should know about the new law right now:

Faster Depreciation Allowed—The depreciation rules are typical of the spirit of the new law. Their aim is to encourage new investments by giving taxpayers a break—in this case by allowing faster and larger write-offs in peak tax-rate years.

You can now choose any of several methods for depreciating your property. You can take: (1) the old straight-line method, stretching equal deductions over the useful life of plant or equipment; (2) a "declining balance" method or a "sum of the digits" method, both of which enable you to recover about one-half the cost of an asset in about one-third of its useful life; (3) any other reasonable method of depreciation that fits your business (for instance, a rate of depreciation tied to your rate of production).

Here's a brief example of how these methods work:

Suppose in 1954 you buy a new factory building for $25,000. The estimated useful life of the building is 50 years. Under straight-line depreciation, you get a deduction of 2 percent each year, or $500. Under the declining balance method, you take 4 percent—not 4 percent of the cost, but 4 percent of the remaining balance each year. In other words, over the first three years, you would deduct:

1st Year: 4 percent of $25,000, or $1,000.

2nd Year: 4 percent of $24,000, or $960.

3rd Year: 4 percent of $23,040, or $921.60.

In comparing the straight-line method with the declining-balance method, keep this in mind: Under declining balance, you get back about 40 percent of your cost during the first quarter of your asset's life, about two-thirds of cost through the first half. So if heavy deducions in the early years of the property's life are important to you, you can use this system. Otherwise, if you have no high income to offset right now and want to keep your deductions constant, the straight-line method is still available.

The sum-of-the-digits method has much the same effect as the declining-balance system. There's this difference, though: Sum-of-the-digits permits you to set your own salvage value; under declining-balance, the value is automatically fixed.

Say you buy a machine in 1954 for

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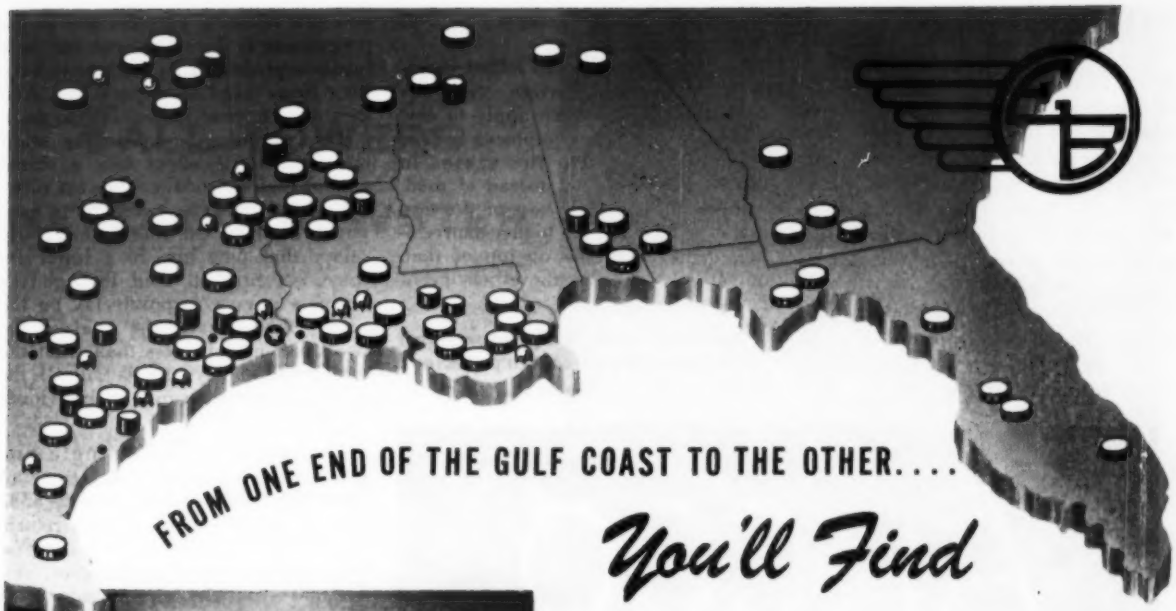

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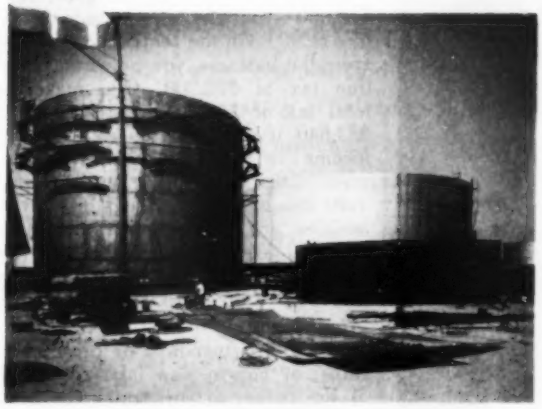
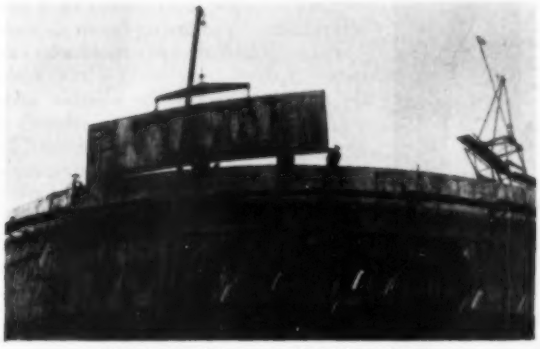
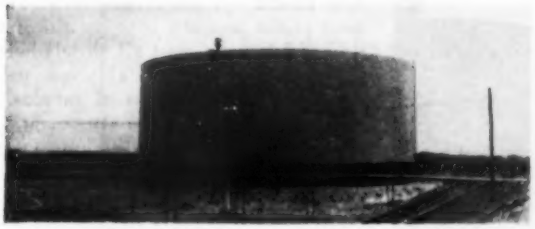


Erection of two medium size dome roof tanks.



Hanging a plate on a 96,000 barrel tank.



A completed 120' diameter x 48' high cone roof tank.

Among the many reasons why so many tanks in the Gulf coast area have been erected by Ellerbee Brothers—why so many of our clients attest to our superior service—is the attention to detail—in every step of the job from drawing board to finished tank. Every seam, every plate is exactly according to specifications—and there is an Ellerbee inspector on every job to make sure. It's trite—but still true—that the little things make a big difference in our service. Next time let us quote on any of your requirements for field erected storage tanks and spheres.

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$175. It has an estimated useful life of five years and an estimated salvage value of $25. Under sum-of-the-digits, your deductions on the machine for the first year would equal 5/15 of $150 (cost less salvage value), 4/15 the second year, 3/15 the third year, and so on. The rate for any year consists of a fraction. The numerator of this is the number of the year taken in reverse order, in this case 5. The denominator is the sum of the numbers representing the remaining years of life, 1 plus 2 plus 3 plus 4 plus 5 in this case, 15.

Besides giving you an added incentive for new construction, these depreciation rules—which apply to new buildings and new equipment bought after 1953—may tip the scales in favor of buying new, instead of used, equipment. The extra cost of the new might be offset by the higher depreciation deductions. And on top of that, of course, you have the efficiency of new equipment.

Partners and Proprietors Can Elect to be Taxed as Corporations—The most important change in the new law affecting partners and single proprietors is this: They can cut their business-profits tax by electing to have their firms taxed as corporations. And they don't have to incorporate to do it.

This can mean a lot to the small businessman. It offers him a shield against high personal income tax rates. By choosing to be taxed on a corporate basis, he can limit himself to a salary that puts him in a lower income tax bracket. And through the business pays a corporate tax on the profits that remain, the total of the two taxes may be less than what the owner would have to pay if all the income was reported on an individual return.

Example: You, as a single proprietor, have a business income of $100,000. You now pay a tax of $53,640 on that if you file a joint return. If you elect to be taxed as a corporation—and you take a salary of, say, $35,000—you pay an individual tax of $11,900. On the remaining $65,000 from the business, you pay a corporation tax of $28,300. That makes a total tax of $40,200, compared with $53,640 if you had reported all the income on a joint return. However, your real, over-all tax saving isn't quite this big; the earnings left in the business are subject to a future capital gains tax of about $9,000. But even figuring that, you still come out with a savings of about $4,000 by choosing the corporate basis.

Not all partnerships or proprietorships, of course, can take advantage of the switch to corporate reporting. There are certain strings attached. For instance, capital—in the form of inventory or equipment—must be a material income-producing factor in your operation. And even for those who can make the change there are some definite drawbacks. The election once made is irrevocable—unless there's a change of ownership of more than 20 percent. It rules out any participation in a qualified pension or profit-sharing plan of the business.

On balance, though, the new provisions amount to this: If they fit your case—and needs—they can mean sizeable tax savings.

Accumulation of Surplus Rules Are Eased—A major accomplishment of the new law is to get rid of a trap that faced almost all closely-held corporations—the penalty on unreasonable accumulation of surplus.

The new ground rules allow you to move safely within a wide area—put aside profits for future expansion or emergencies, even plan dividend declarations so they work to your tax advantage. The old law left the burden

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'Dry-Air GAS
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This new Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases automatically corrected to the humidity content of the air. The difference in weight between a column of GAS and equal column of DRY AIR is measured. This ratio represents the true specific gravity of the sample.
One bell of the instrument is filled with gas which is being measured, and the other bell is filled with dry air. Otherwise, except for the new instrument having one column for gas and one column for dry air, the unit is identical in operation to the standard gas gravitometer. When calibrated and properly installed, these instruments require little attention other than to wind the clock, ink the pen, and change the chart. Send for bulletin No. 101.
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The best way to cool water for your vital refinery processes is with Pritchard heavy-duty cooling towers.

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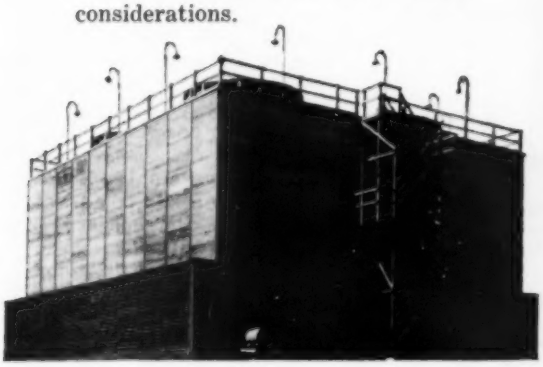
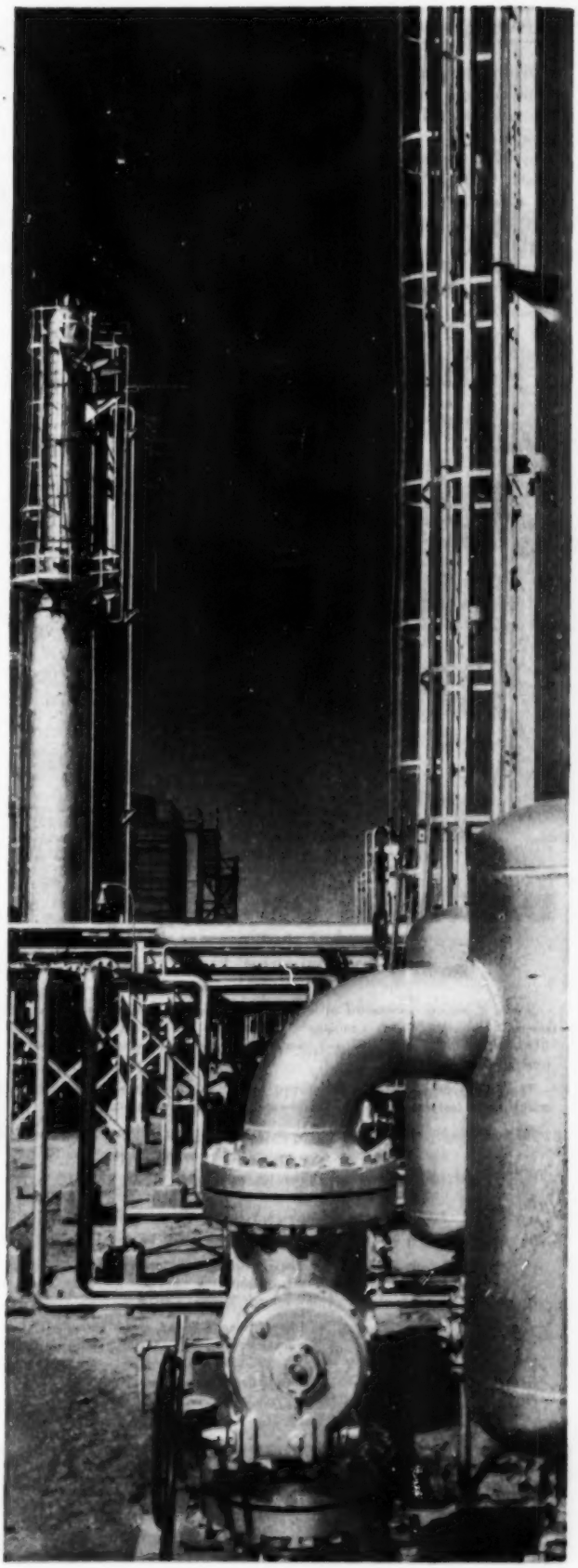
You can depend on Pritchard to satisfy these two important considerations.





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of proof on what was a "reasonable" accumulation of surplus strictly up to the company. There was no specific exemption, and penalties were stiff for those who ran afoul of the Treasury.

Now that's all changed. Under the new Code, you can accumulate up to $60,000, without penalty, to meet reasonably anticipated business needs. Where you pile up more than the $60,000, the burden for proving it to be unreasonable is now on the Treasury. And even if you do transgress, the penalties are lighter. They used to be applied to the entire amount of the retained earnings. Now you pay only on the portion that's an unreasonable accumulation.

Accounting Changes You Can Make—The new law makes it a great deal easier to choose or switch around your accounting methods. Here are just a few of the things it allows:

- You can use a 52-week or 53-week fiscal year instead of a calendar year or fiscal year ending on the last day of a month. A business can thus change its accounting period to end on a certain day each month—rather than on the variable end of the month. Advantage: Fewer adjustments to make on your tax return (you can end your year at the end of a working week—and so take inventory over the weekend).
- If you have an installment dealer who reports on the accrual basis, you can shift to the installment basis—without paying a double tax on the income already reported under the accrual system. If you change to the installment basis, you get a credit each year for the tax on the income that you have already reported on an accrual basis. Note, however, that the new rules apply only to 1954 and the years that follow.
- You can now set up reserves for future estimated costs—cash discounts, vacation pay, self-insurance for injury and damage claims, returns and allowances, and the like. But check carefully here to see just what the law says you can and can't do. Estimated reserves will have to be reviewed each year. If they are too big, the excess must be added back to income.
- If you are on an accrual basis, you can now spread prepaid income over the period in which it will be earned—up to a limit of five years after the year you receive it. Under the old law, you had to report the money in the year you got it. This change suggests an inexpensive way to finance your business: Offer discounts for advance payments; if the discounts are less than the interest you would otherwise pay for the use of the money, you're ahead.
- Hybrid accounting methods, the new law says, are now perfectly O.K. For instance, you can use the accrual method to report sales and purchases, a cash basis for deductions for rent, wages, interest, and insurance. In effect, this gives a green light to small business to use whatever accounting methods suit their operations best. And there's no worry about having to adjust for tax purposes.

Loss Carryover Rules Eased—For businessmen who have had good profit years and who are now running into losses, the new rules for carryback of net operating losses are a welcome change. You can now carry back a loss against the profits of two preceding years—not just one, as the old law allowed. And the new law is more liberal in the reductions you have to

DAY MAN ON THE JOB . . .

Experience Furnished Pitt-Chem. Users

Here's a regular service to users of Pitt-Chem's cold applied protective Coatings in the area served by the S. D. Day Company* that adds to the value of using these products. When you DEAL WITH DAY, one of his men is present to pass on his knowledge to assure you the best and most efficient application.

The Pitt-Chem. 100 Series cold applied Tar Base Coatings have an outstanding record in reducing maintenance costs for industrial equipment and structures; here are a few:

PITT-CHEM. 101 A versatile heavy duty coating that withstands severest corrosive conditions.
102 A thin, high gloss maintenance coating for steel and concrete surfaces.
103 Excellent protection for metal exposed to corrosive vapors, dilute acids and alkalies.
104 A fast drying high gloss coating that will not transmit taste or odor to water.
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These coatings are stocked in Houston for immediate shipment. Engineering counsel, literature and prices are furnished through our Houston Office.

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TURBO-MIXER, a division of

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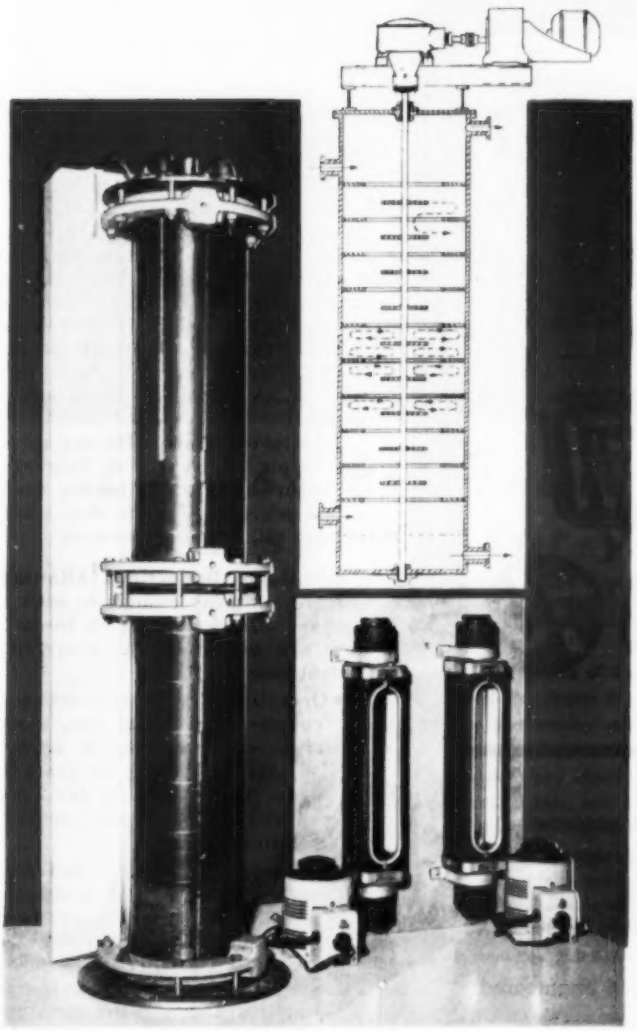

Demonstration model—used to show how the R.D.C column actually operates

Turbo-Mixer R.D.C.* Column

Rotary Disc Contactor for Liquid-Liquid Counter-current Extraction

Six years of data and design development in the laboratory, pilot plants and industry have demonstrated the superior features of this practical counter-current and gravity flow extractor. The R. D. C. extractor offers:

1. **high volumetric efficiency**
2. **high throughput capacity**
3. **simplicity of construction**
4. **no interstage or external settlers**
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May we assist you in the solution of your extractor problems? Our laboratory facilities are available for evaluation of your extraction system.

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• Peabody Direct Fired Air Heaters are engineered designed and built to meet individual job specifications in the petroleum refining industry.

They are available in a complete range of pressures and firing rates from 1,000,000 BTU/hr upward.

For complete information on these custom engineered Air Heaters, write for Bulletin 600A.

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As Management Sees It . . .

make in your carryover loss. On top of this, you still have the five-year carry-forward against future profits.

Example: You made a $10,000 profit in 1952 and a $5000 one in 1953. In 1954, you have a $15,000 loss. Under the old law, you could carry back your loss only to the $5000 in profits earned in 1953. That would mean a refund on 1953 taxes, but the other $10,000 of the loss could be applied only against future profits. Now, under the new law, you can go back two years, which in this case uses up the entire loss. A refund is in store on both 1952 and 1953 taxes.

Research Expenses Can Be Deducted—The old law was muddled about research costs. In most cases, small companies had to capitalize and write off expenses over the useful life of the benefit. Or, much later, they could deduct them as an abandonment loss.

That's all different now. You can deduct research and experimental expenses in the year the cost is incurred. Or you can elect to amortize the expense over a period of five years or more. However, once you decide how you want to handle the costs, you can't change unless you get Treasury approval.

One note of warning: The new rules don't apply to land, or to buildings and other depreciable property used in research work. Nor do they cover mineral, oil, or gas exploration.

Additional Deductions Allowed—There are many changes in what a company can deduct from income. Here are several of the more important ones:

- Organization expenses to set up a corporation—legal fees, stock taxes, etc.—can now be written off over a period of five years or more. Under the old law, you couldn't take them until the corporation folded up.
- The new law makes a bad debt out of any bad debt contracted while you or your company is in business. This holds even if the debt goes sour after the company goes out of business. The old rule was that a debt that turned bad after a taxpayer had gone out of business wasn't a bad debt. That meant the taxpayer was deprived of a fully deductible loss against ordinary income. The reason: A nonbusiness bad debt is deducted only against capital gains and ordinary income up to $1000.
- Corporate charitable contributions

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Let Us "FIRE-ENGINEER" a system for your plant with AER-O-FOAM

The science of fire-engineering has come a long way since the era of the horse-drawn fire engine. Now you can protect your flammable liquid fire hazards by calling in National Foam engineers, who survey your plant and plan a modern fire-engineered system for your particular needs. They check locations, processes, flash points, existing system, water supply, and other factors. They recommend a basic AER-O-FOAM System with manual or automatic control, stationary or mobile operation, and all the proper equipment . . . foam chambers, overhead units, dip-tank systems, nozzles, extinguishers. After installation, National Foam furnishes a complete operating manual.

National Foam's modern fire-engineered service offers the best in system design, equipment, and instant, positive, fire-tested AER-O-FOAM. Call in National today to discuss your flammable liquid fire problem.

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FOAM SYSTEM INCORPORATED
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For more data on advertised products, use Readers' Service Cards, last page.

Okadee

"THE PERFECT SEAL"

WRING FIT

No magic... No magnetism... lapped wring fit of every Okadee Valve disc and seat must pass this test of a perfect sealing surface. (unretouched photo)

...Here's What it Means to You in Terms of Valve Service

Flat mating surfaces within .000005", or less, of every set of Okadee valve discs and seats mean absolute shut-off of any material from ammonia gas to asphalt.

How long does this seal last in service? We honestly don't know. Tests under working conditions with propane were stopped after 269,000 operating cycles when no wear or seal failure could be detected. And Okadee valves do not have to be babied in service on corrosive or abrasive materials . . . Thousands of boilers have had Okadee blow-down valves in continuous, trouble-free service for fifteen years or more. If Okadee size-pressure-temperature ranges include your valve applications, Okadee installation will end your problems of valve performance once and for all.

Okadee valves are available in single-disc (one direction) and double-disc (two directions) types; screwed or flanged; ½" to 6" in standard A.S.A. dimensions; steel or semi-steel bodies (other materials to order); stainless steel or stellite seat facings; levers, rack-and-lever, worm-gear, hydraulic, pneumatic, automatic on-off control.

Write for Bulletin 332-G today!

OKd. Okadee COMPANY
332 South Michigan Avenue • Chicago 4, Illinois

As Management Sees It . . .

that top the 5 percent limitation can now be carried over to two succeeding years — provided they're within the 5 percent limit for those years. Under the old law, any excess within a year was lost to the corporation.

Other Changes—There are scores of other ways in which the businessman will find the new tax law an easier one to live with. For instance:

- Stockholders of closely held corporations are now eligible to cash in on the tax benefits of restricted stock options. The old law barred anyone who owned more than 10 percent of a company's stock from getting them.

  Now a person holding more than 10 percent of a company's stock can take a restricted option provided the option price at the time the option is granted is at least 110 percent of the value of the stock. The option must be exercised within five years of the time it is granted, or within one year after the enactment of the law.

- Distributors and dealers can now apply capital-gains rules to the payments they get when their franchise or distributorship is cancelled. However, they must have made substantial investments in the facilities of the distributorship.

- The threat of a double tax in the sell-out of a corporate business is now all but removed. Under the old law, a double tax was always a danger: The first when the corporation sold the company's assets; the second when the stockholders received the proceeds in liquidation. Now a corporation that plans to sell out can adopt a plan of complete liquidation. If it sells all its assets—except for certain inventory items and installment obligations—within 12 months after the adoption of the plan, there is no tax. The only bite is on the stockholder when he gets the proceeds of the liquidation. And he pays then only if the proceeds are more than the tax basis of his stock—and only at capital gains rates.

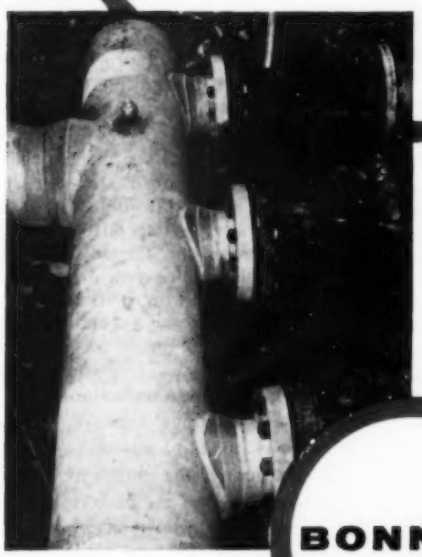
- The new law gives you specific tax protection in cases where a creditor cancels some of your debts. It used to be that the courts would often have to decide

See TAX LAW, Page 400

YES - 1954 is the year of sharp pencils

FOR REAL SAVINGS
IN WELDED BRANCH FITTINGS
SHARP PENCILS SPELL . . .

WELDOLETS



$700 was saved because Weldolets were used on the welded header shown at left. (Actual on-the-job photo.)
Weldolets are available in all principal cities from selective warehousing distributors.

WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

721 MEADOW ST., ALLENTOWN, PENNA.

For more data on advertised products, use Readers' Service Cards, last page.

Catawissa
PERFECT SEAL
Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

Standard & Double Extra Heavy
LUG NUT UNIONS
Hammer-type for quick opening and quick closing.

WRITE FOR CATALOG 11
showing the complete Catawissa line of Perfect Seal Products

CATAWISSA VALVE AND FITTINGS COMPANY
25 Mill St. — CATAWISSA, PA.

As Management Sees It . . .

Bacteria, Oil's Rediscovered Frontier

David G. Willis,
REFINER Staff

IN THE STRANGE and ofttimes incredible world of bacteria, man has uncovered a few why's and wherefore's of his own existence. The concensus, after almost 80 years of study: bacteria, smallest living creatures known, are both harmful and helpful to mankind; to paraphrase man's frequently used appraisal of women—with bacteria, life is difficult, without them, it would be impossible.

Through the chemistry of their composition, bacteria produce chemical reactions in the matter around them. In the human bloodstream, for instance, certain types of these minute catalysts cause the formation of toxins now commonly recognized as the cause of such major diseases as diphtheria, typhoid fever and cholora. By studying these microorganisms, man has been able to develop antitoxins and make tremendous strides in his fight against disease. Other varieties of bacteria have more beneficial tendencies; they cause fertility in soil, find use in the baking industries, and are used to produce alcohols, acetone and other products in the fermentation industries.

Since the discovery of the relationship of bacteria to disease, study of the tiny unicellular organisms has been fairly restricted to applications in medicine. As a result, progress has almost halted in the investigation of bacteriological problems in industry, one of the earliest functions of bacteriologists.

A reversal of that trend in the petroleum industry is heralded in a new book, *Petroleum Microbiology*, published by Elsevier Press, Inc., 300 Park Avenue, New York. The author is Dr. Ernest Beerstecher, Jr., a biochemistry professor at the University of Texas Dental School in Houston. Dr. Beerstecher believes that the study of ways and means of harnessing the unusual catalytic properties of bacteria for the good of the petroleum industry and of stemming their destructive activities is about to come into its own as a new and separate field, petroleum microbiology. In fact, he told PETROLEUM REFINER in an interview, several companies have already set up staffs of bacteriologists to study the obstreperous creatures.

In his new book, Dr. Beerstecher, former company consultant and research worker in the field, has attempted to compile into one volume a general roundup of the information now available in this new field. This task, which took almost four years, turned out to be quite an undertaking since (1) not too much was known, and (2) those who knew, such as major oil companies, were tight-lipped about their findings because of the tremendous potential payoff.

One company, the author reported, holds meetings on its bacteriological findings in a small room, which has the windows covered with heavy paper and the door guarded. After the meetings, the author related, all notes and scraps of paper are destroyed.

Because he is not associated with a

TAX LAW

Continued from Page 398

> whether the cancellation constituted income to you. Now there's a simple way out: You merely reduce the tax basis of your property by the amount of the discharge. All you have to show is that you incurred the debt in connection with property used in your trade or business. You don't have to be incorporated, nor does the debt have to be a secured one.

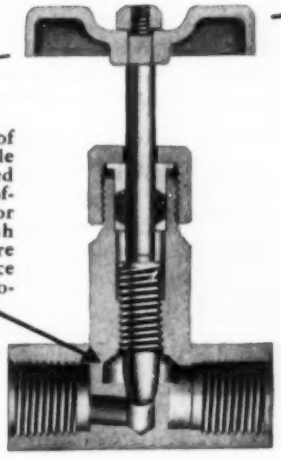
These are only a few of the immensely important benefits that the new tax law offers to business. It's your responsibility to take full advantage of all of them—each and every one that applied to your operation. Part II of this report, to be used in an early issue, will show how some of the new provisions can work toward building a happier, more efficient work force for your company.

MAXIMUM WORKING PRESSURE
10,000 PSI
for water, oil or gas

- Body and stem guide extra heavy bar stock fused into one piece.
- Valve stem 416 stainless steel.
- Packing special one-piece "Marpak" moulded ring.
- Bodies marked in accordance with MSS regulations.

ONE PIECE

The stem guides of conventional needle valves are screwed into bodies—this often causes leakage or blow-outs. Marsh Needle Valves are fused into one-piece by exclusive "Conoweld" process.



Introducing-

The Ultimate in Needle Valves

Here is one of the crowning achievements of Marsh research, design, and manufacturing skill. It is the first needle throttling and shutoff valve to combine *all* of the qualities called for today in this highly critical and ever broadening field.

It is a valve that has strength and safety to spare . . . rated for pressures up to 10,000 psi—equally efficient in the lower ranges. A product of Marsh instrument-making and valve manufacturing experience, it combines instrument-like precision with the ruggedness that distinguishes all Marsh valve specialties.

The illustrations tell the story of new thinking; new standards. Body and stem-guide are machined from extra-heavy carbon steel bar stock. Still greater strength and rigidity are achieved by fusing the stem-guide into the body. The complete fusion of guide and body is accomplished by the exclusive Marsh "Conoweld" process.

There are two big advantages to this one-piece construction: (1) It eliminates the danger of unscrewing the valve from the body when opening—a frequent cause of leakage, even dangerous blow-outs (2) It permits perfect line-up of threads and seat. As a result, Marsh valves are easier to operate even at high pressures.

The precision-machined stem is 416 stainless steel. Stem threads are fine pitch for extra strength and fine, controlled regulation. Notable advancements are special "Marpak" one-piece, non-binding longer-lasting packing; deep thread chambers, keeping inlet and outlet piping away from ports and contributing excellent flow characteristics. Entire packing nut and packing gland are electro-zinc plated, preventing corrosion and giving the valve a handsome, plated exterior. The rugged malleable handle is finished in heavy baked enamel.

The new needle valve line includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾" and 1". Also globe and angle valves with male inlet and female outlet in sizes ¼" and ½". *Complete stock carried at our Skokie, Illinois factory and also at our branch plant in Houston, Texas.*

Write today for catalog giving complete details.

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*
Dept. R, Skokie, Ill.
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

MARSH

"THE STANDARD OF ACCURACY"

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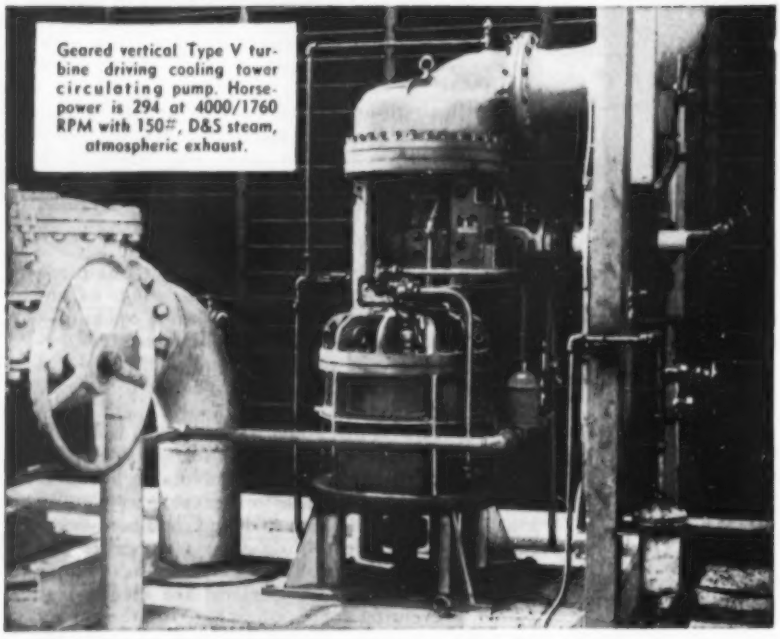
Murray Turbines



Geared vertical Type V turbine driving cooling tower circulating pump. Horsepower is 294 at 4000/1760 RPM with 150#, D&S steam, atmospheric exhaust.

● Murray Vertical V turbines, both geared and direct-connected, are being used more and more for driving vertical pumps of all types. The Murray Vertical V turbine is designed from top to bottom as a vertical turbine, not just a horizontal turbine, "upended." The Murray Vertical is especially constructed and arranged for vertical mounting.
Murray vertical turbines can be furnished for steam pressures up to 600#, 750° F. TT. and back pressures as high as 100# and can carry most normal thrust loads imposed by vertical pumps.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

As Management Sees It . . .

company engaged in research in this new field, Dr. Beerstecher is in the position of being free to seek out information and to write it. While being interviewed, the author said impetus for writing the book came from the fact that nothing on this field of endeavor has yet been published. His purpose was to build a foundation from which future researchers could start.

Covered in his book are such subjects as the roles of microorganisms in: geological processes, the synthesis of petroleum, drilling muds, petroleum exploration, corrosion and other petroleum divisions.

Some of the findings on the uses of bacteria in the petroleum industry reported by the author are:

In manufacturing—microorganisms can be used to supplement and broaden the present scope of operations. Example: by bubbling gases through a column of bacteria, it is possible to produce a fair food product. Still other applications are just over the horizon.

In exploration—microorganisms can be used to find hydrocarbon gases. Since these gases can mean an oil reservoir, finding them with "trained" organisms could prove highly practical.

In drilling—bacteria in muds may multiply so rapidly at high underground temperatures that the fluid mud can become solid, freezing the well completely. Through study of these bacteria, it may be possible to develop a bactericide which would kill off the offending organisms.

In secondary recovery—use of antibacterial agents in the injection waters promotes greater production.

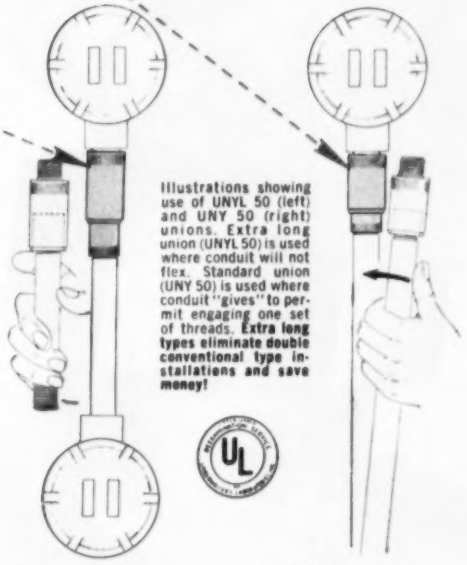
These are merely a beginning. Because so little research has been done and/or reported, no one can or will say how far petroleum microbiology can go.

Not a great many answers to petroleum problems are contained in Dr. Beerstecher's book. What the author has done is to offer a look at a new approach to solving those problems and to speculate on the potential fabulous tomorrows in petroleum's future.

In their own unconcerned way, bacteria will continue to run about causing chemical reactions. But from now on, Dr. Beerstecher maintains, there is a strong likelihood that the petroleum industry is going to be watching them and learning.

NEW! Self-Adjusting Explosion-Proof EXPANSION UNIONS by APPLETON

Explosion-Proof... Fully Extended or Intermediate Positions



Illustrations showing use of UNYL 50 (left) and UNY 50 (right) unions. Extra long union (UNYL 50) is used where conduit will not flex. Standard union (UNY 50) is used where conduit "gives" to permit engaging one set of threads. **Extra long types eliminate double conventional type installations and save money!**

EXTRA LONG
UNYL Union showing up to 1-11/32" expansion . . . serves the purpose of two conventional type unions!

STANDARD
UNY Union showing up to 21/32" expansion . . . for installation wherever conventional types were previously used!

Only ONE Unit . . . Two Moving Parts

APPLETON Explosion-Proof Expansion Unions are completely new and different . . . afford an ease and simplicity of installation never before known with this type of explosion-proof equipment!

Expansion adjustment is built-in! The *two* moving parts telescope or expand to accommodate usual thread lengths. Only *two* tightening operations . . . each made separately! Smaller external diameters for convenient use in restricted quarters! Precision construction for absolute explosion-proof protection . . . no need to worry about failure to draw surfaces together . . . the union remains completely explosion-proof at all times, regardless of its retracted or extended position! Special design guarantees positive ground at all times!

Get acquainted with the *extra* quality and utility built into APPLETON Explosion-Proof Expansion Unions. Write for complete details.

Sold Exclusively Through Selected Wholesalers

APPLETON ELECTRIC COMPANY
1732 Wellington Avenue · Chicago 13, Illinois

Also Manufacturers of:

Rely on **APPLETON** *... The Standard for Better Wiring*

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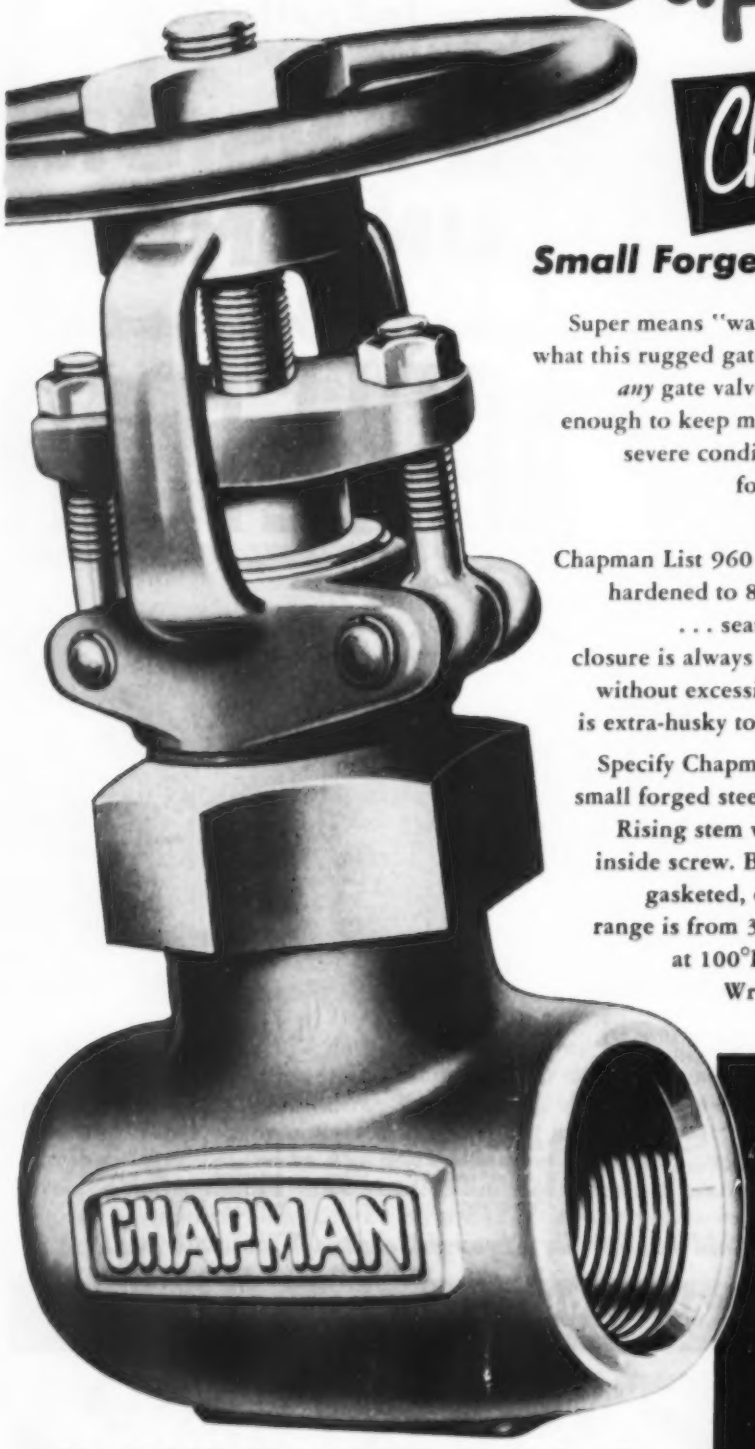
Super Tough

Chapman List 960

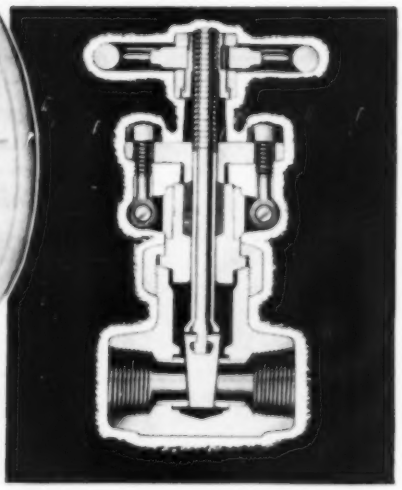
Small Forged Steel Gate Valve



Super means "way beyond the ordinary" and that's just what this rugged gate valve is . . . it's tough enough to lick *any* gate valve problem in its range . . . dependable enough to keep maintenance costs down under the most severe conditions. That's why List 960 is specified for more different applications than any other valve of its kind.

Chapman List 960 is tough because . . . wedge faces are hardened to 800 Brinell, so they won't seize or gall . . . seat rings are hardened stainless steel, so closure is always tight and operation is always smooth, without excessive wear . . . stem-and-gate connection is extra-husky to stand up under even unusual stresses.

Specify Chapman List 960 for every use you have for small forged steel gate valves. In sizes from ¼" to 2". Rising stem with yoke (shown) or rising stem with inside screw. Bonnet joint is either metal to metal or gasketed, depending upon application. Pressure range is from 380 pounds at 1000°F to 2000 pounds at 100°F. For higher ratings, specify List 990. Write today for your copy of Catalog 10.



The CHAPMAN Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

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HAVE YOU CHECKED YOUR BOILER WATER TODAY?

FOR QUICK AND EASY SAMPLE TAKING, use the

Paracoil
BOILER WATER SAMPLE COOLER #75

shown above, with Sample Flow Control Valve and Hose Connection Nozzle. (A quadrant of the Cooler Shell has been cut away to show internal construction).

Note these exclusive design features:

- HEAVY CAST BRONZE SHELL (Navy Comp "M")
- CUPRO-NICKEL COOLING COIL
- HEAVY CAST BRONZE COIL SUPPORT CORE
- STURDY BRASS UNION TYPE COIL NUTS
- BUILT TO ASME, USCG, ABS and LLOYDS SPECIFICATIONS

Available for immediate shipment from stock—with or without Flow Control valve. Special designs built for Industrial and Chemical Process Applications.

Write for Bulletin #110

Full of valuable installation data and water flow rate curves.

see our catalog in INDUSTRIAL CONSTRUCTION FILE or write for copy

DAVIS ENGINEERING Corporation

1064 E. Grand Street, Elizabeth 4, N. J.
30 Rockefeller Plaza, New York 20, N.Y.

Who's Meeting . . .

WPRA at Casper . . .

. . . **Western Petroleum Refiners Association** will hold a regional Technical-Industrial Relations Meeting at Casper, Wyo., September 23-24.

A number of interesting technical papers, dealing with subjects suggested by refiners in the Rocky Mountain region, will be presented at the Friday technical session and include: "Fluid Coking Yield Studies," co-authored by F. B. Johnson and R. E. Wood, Esso Standard Oil Company, Baton Rouge, La.; "Asphalts from Rocky Mountain Crude Oils," by K. E. Standfield, Petroleum Oil Shale Experiment Station, Laramie, Wyo.; "Electric Mercaptan and Amine Salt Hydrogen Sulphide Processes," prepared jointly by C. W. Rippie and Oliver Zandona, Electric Process Company, Summit, N. J.; "Refinery Fire Insurance Rating," presented by R. B. McClelland, resident manager, Tulsa Region, Oil Insurance Association, Tulsa.

The Industrial Relations Session will be conducted Thursday, September 23, with F. E. Mathews, superintendent, Industrial Relations division, Standard Oil Company (Indiana), Casper, serving as chairman. Featured on the industrial relations program will be a paper, "How One Company Benefited from Employe Opinion Survey," presented by Curt Holton, director of industrial relations, Ethyl Corporation, New York. Proper techniques for conducting a survey and methods for utilizing the results will be discussed by Holton.

ASME at Los Angeles . . .

. . . **The Ninth Annual Petroleum Mechanical Engineering Conference** will get underway September 26 through 29 in Los Angeles. Papers to be presented at the refining session include the following:

- "Mechanical Features of the Hyperforming Process," Clyde Berg, Union Oil Company of California.
- "Mechanical Advancements in the Alkylation Process," Robert Stiles, The M. W. Kellogg Company.
- "Economics of Design of Heat Exchangers," E. D. Anderson, Western Supply Company.
- "Design Problems and Applications of High Speed Turbines," H. Steen-Johnson, Elliott Company.
- "Field Coordinating Organization for Improving Efficiency of Petroleum Refinery Maintenance," E. C. Hermann, Esso Standard Oil Company.
- "Field Welding of Heavy Wall Vessels," F. A. Upson, Standard Oil Company (Indiana).
- "The American Standard Code for Pressure Piping," F. S. G. Williams, Taylor Forge & Pipe Works.
- "Allowable Membrane Stresses for Welded Carbon Steel Boiler and Pressure Vessels," W. P. Kerkhof, Asiatic Petroleum Corporation.
- "Stresses from Local Loadings in Cylindrical Pressure Vessels," P. P.

RIGHT WHERE IT COUNTS!

IRVING "GRIDSTEEL" CONTOUR RETAINER MESH

Used with Castable Ganister Linings in Refractionating Units in Petroleum & Chemical Industries

RIGHT for

- ★ Thermal Cracking Units
- ★ Cyclones
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- ★ Flue-Gas Stacks & Ducts
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REDUCE EXPENSIVE SHUTDOWNS by using Irving "GRIDSTEEL", the quality contour retainer mesh.

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ESTABLISHED 1902

OFFICES and PLANTS at
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in the Field

on the Pipe Lines

in the Plants

It's MANZEL

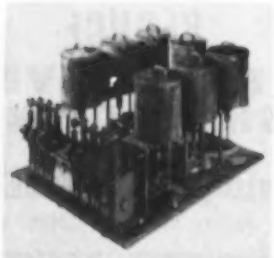
FOR FORCE FEED LUBRICATORS

Pressure Application — Exact Amounts — Accurately Timed

On pumps and compressors . . . on engines and other machinery . . . dependable, automatic lubrication can best be had with Manzel Force Feed Lubricators. They lower labor costs . . . reduce oil consumption . . . prevent costly breakdowns. When specially engineered installations are called for, Manzel has the know-how to do them.

AND FOR CHEMICAL FEEDERS

Single or Multiple Feed — From a Few Drops to 60 gal./hr.



In pipe lines, oil tank and bottom hole treatment, Manzel Chemical Feeders automatically introduce the various compounds in accurately measured quantities. You eliminate guesswork, inaccuracy and neglectfulness. Here again, if unusual installations are called for, the Manzel organization will engineer them. For information write:

Manzel

DIVISION OF FRONTIER INDUSTRIES, INC.
285 BABCOCK STREET BUFFALO 10, N. Y.

Who's Meeting . . .

Bijlaard, Cornell University.

- "Space Supports—The Circular Pedestal," N. A. Weil, The M. W. Kellogg Company.
- "A Look Ahead in Pressure Vessel Design," E. W. Jacobson, Gulf Research and Development Company.

NPA at Atlantic City . . .

. . . **The National Petroleum Association's** annual meeting September 15 through 17, Atlantic City, will include speeches by some of the nation's outstanding leaders: Dr. Charles F. Kettering, General Motors Corporation, Chester F. Smith, Standard Oil Company (New Jersey), Sinclair Weeks, Secretary of Commerce, and Lieutenant General Ernest O. Thompson, Railroad Commission of Texas. The technical section of the meeting will hear a symposium on one of the most hotly debated subjects in lubricating oil manufacturing marketing—the multi-viscosity graded motor oils. Do they save gasoline? Do they reduce deposits? Do they protect the engine? General Motors, Kendall, Quaker State and Socony-Vacuum representatives will give their views.

API at New York . . .

. . . **The American Petroleum Institute's** committee on evaporation loss will meet October 15 in New York, according to J. H. McClintock of Esso Standard Oil Company. This committee is attempting to find ways and means of evaluating reducing losses of evaporation of crude oil petroleum products.

Prior to the meeting of the full committee, the four principal subcommittees will convene in separate sessions. These subcommittees and their chairmen are as follows: "Methods of Testing," H. M. Hart, Standard Oil Company (Indiana), Whiting, Ind.; "Correlations," A. B. Stevens, General Petroleum Company, Torrance, Calif.; "Field Test Program Developments," H. C. Packard, Shell Oil Company, New York, and "Program and Publications," E. L. Hoffman, Socony-Vacuum Oil Company, New York.

AIChE at Galveston . . .

. . . **The American Institute of Chemical Engineers,** South Texas Section, will hold its forthcoming annual meeting October 22 at Galveston, Texas.

Divided into four parts, the one-day meeting will have a General Session, a Symposium on Engine Deposits, a Symposium on Trends in the Gulf Coast Chemical Industry, and a Student Session.

Important papers to be presented will describe methods of statistical control, economics of ammonia manufacture, selection of plant sites, problems related to engine deposits, and the general petrochemical outlook for the Gulf Coast. By popular request the special student session contains papers outlining current labor laws, economics, and insurance programs of interest to the young engineer.

For more data on advertised products, use Readers' Service Cards, last page.

Above unretouched photograph shows the "guts" of the original 2" style 50 single ball race CHIKSAN Swivel Joint after 20 years of rigorous service in the California oil fields. Note the good condition of the wearing surfaces. This joint has been improved through the years to the present modern double ball race joint.

The CHIKSAN Ball Bearing Swivel Joint illustrated above is an unretouched photograph of a veteran of 20 years service on an oil well cementing hose.

CHIKSAN IS NO "JOHNNY COME LATELY" TO INDUSTRY...

Modern types of CHIKSAN swivel joints.

- Over a quarter of a century of "know-how" in design, manufacture, and successful application of swivel joints.
- Originator and largest exclusive manufacturer of ball-bearing swivel joints.
- The widest range of styles, sizes and pressures available for every major industry.
- Packing designs available for each specific service, assure constant torque at any given pressure.
- World-wide recognition for highest quality and lowest maintenance costs.
- Complete nation-wide coverage by qualified field service engineers.
- If you require unlimited flexibility with unlimited life—be sure you *specify* and *buy* CHIKSAN Ball Bearing Swivel Joints.

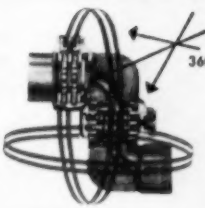
Supply and Service of CHIKSAN Ball Bearing Swivel Joints is always as near as your telephone. Write CHIKSAN for Specific Catalog Information. Dept. 9-PR

The Flow of Enterprise Relies on

CHIKSAN

Ball-Bearing Swivel Joints

THE NEW TOOL OF MODERN INDUSTRY



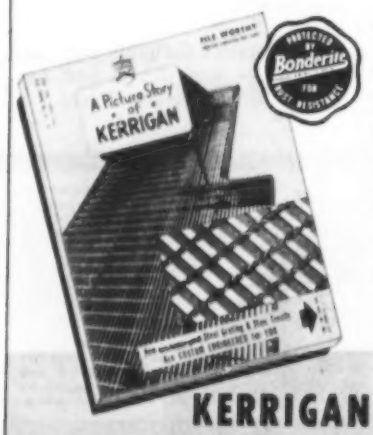
CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles, and sizes have been developed for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 70° to a plus 500° F. with packing materials for each specific service.

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 3, Illinois • Newark 2, New Jersey

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Co., Brea, Calif., Newark 2, N.J. • Chiksan of Canada Ltd., Edmonton, Alta.

Custom-Made for YOUR Job!

Electronically Weldforged and Bonderized for greater safety, strength and longer life, Kerrigan grating is custom fabricated to your exact requirements. Our large drafting staff is at your service to prepare drawings subject to your approval . . . and the finished grating comes to you well marked and identified for low cost installation.



Bearing bars, and cross bars alternating right and left for the utmost in safety, are weldforged into one-piece, inseparable units. Write for your FREE copy of illustrated booklet as shown. It contains complete engineering data and shows how Kerrigan's *never-fail* weld stands up under the severest kind of punishment.

Write for FREE desk-size grating sample.

KERRIGAN IRON WORKS, Inc.

General Sales Office — 274 Madison Ave. — New York City

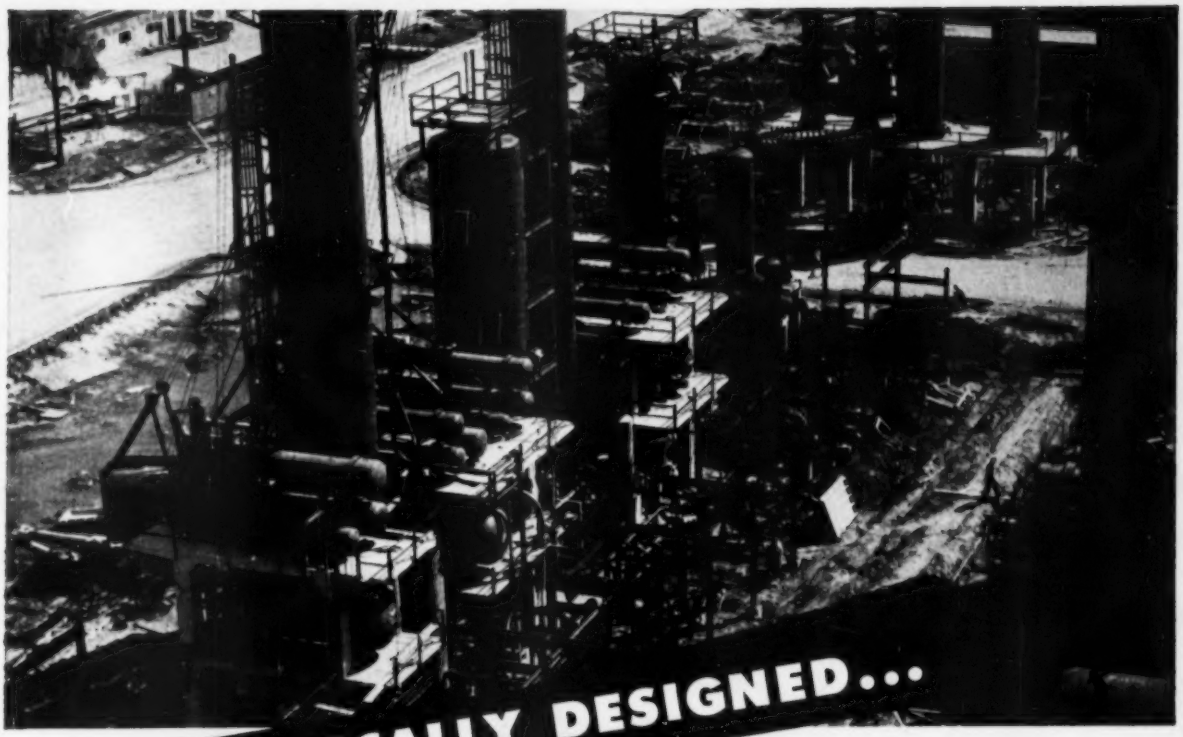
Who's Meeting . . .

In the Future . . .

Other meetings on the oil man's calendar are shown below.

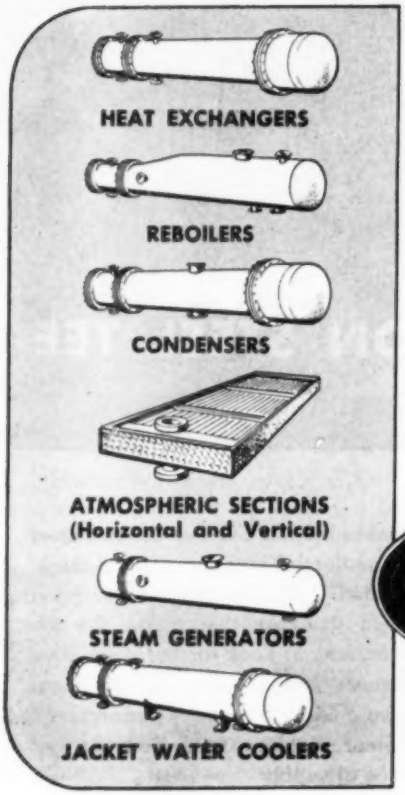
CALENDAR OF MEETINGS

SEPT.	
8–10	Oil Industry Information Committee, Conrad Hilton Hotel, Chicago.
8–10	American Society of Mechanical Engineers (Fall Meeting), Schroeder Hotel, Milwaukee, Wis.
12–16	American Institute of Chemical Engineers, Hotel Colorado, Glenwood Springs, Colo.
12–17	American Chemical Society, New York.
13–24	First International Instrument Congress and Exposition, Commercial Museum and Convention Hall, Philadelphia.
15–17	National Petroleum Association (52nd Annual Meeting), Traymore Hotel, Atlantic City, N.J.
15–17	American Petroleum Institute Lubrication Committee, Traymore Hotel, Atlantic City, N.J.
17	Natural Gasoline Association of America (Regional Meeting), Skirvin Hotel, Oklahoma City, Okla.
23–24	Western Petroleum Refiners Association (Regional Meeting), Henning Hotel, Casper, Wyo.
27–28	Symposium on Methods for Testing Liquefied Petroleum Gases, Statler Hotel, St. Louis, Mo.
27–29	American Institute of Electrical Engineers (Joint Meeting with Tulsa Engineers Club), Mayo Hotel, Tulsa.
27–30	American Society of Mechanical Engineers (Petroleum Division), Statler Hotel, Los Angeles.
OCT.	
3–7	ASTM Committee D-2 on Petroleum Products and Lubricants, Sheraton Park Hotel, Washington, D.C.
7–8	California Natural Gasoline Association (29th Annual Fall Meeting), Ambassador Hotel, Los Angeles.
12–15	Eighth National Chemical Exposition, Chicago Coliseum, Chicago.
14–15	National Association of Corrosion Engineers (South Central Regional Meeting), Dallas, Texas.
17–20	American Institute of Mining and Metallurgical Engineers (Fall Meeting, Petroleum Division), Plaza Hotel, San Antonio, Texas
18–22	National Safety Council, Chicago.
21–22	Western Petroleum Refiners Association (Regional Meeting), Garrett Hotel, El Dorado, Ark.
25–27	National Lubricating Grease Institute (Annual Meeting), Mark Hopkins Hotel, San Francisco, Calif.
25–29	American Institute of Electrical Engineers (Fall General Meeting), Chicago.
29	Natural Gasoline Association of America (Southern Regional Meeting), Blackstone Hotel, Tyler, Texas.
NOV.	
3–5	The Society of Rheology (Annual Meeting), National Bureau of Standards and Sheraton Park Hotel, Washington, D.C.
4–5	Society of Automotive Engineers (National Fuels and Lubricants Meeting), Mayo Hotel, Tulsa, Okla.
8–11	American Petroleum Institute (34th Annual Meeting), Conrad Hilton Hotel and Palmer House, Chicago.
15–17	American Standards Association (Annual Meeting), Roosevelt Hotel, New York.
28 to Dec. 3	American Society of Mechanical Engineers, Statler Hotel, New York.
Dec.	
2–7	National Exposition of Power and Mechanical Engineering, Commercial Museum, Philadelphia.
3	Natural Gasoline Association of America (Panhandle-Plains Regional Meeting), Herring Hotel, Amarillo, Texas.
8–10	Oil Industry Information Committee, Waldorf-Astoria, New York.
12–15	American Institute of Chemical Engineers (Annual Meeting), Statler Hotel, New York.



SPECIFICALLY DESIGNED...

FOR THE REQUIREMENTS OF THE JOB!



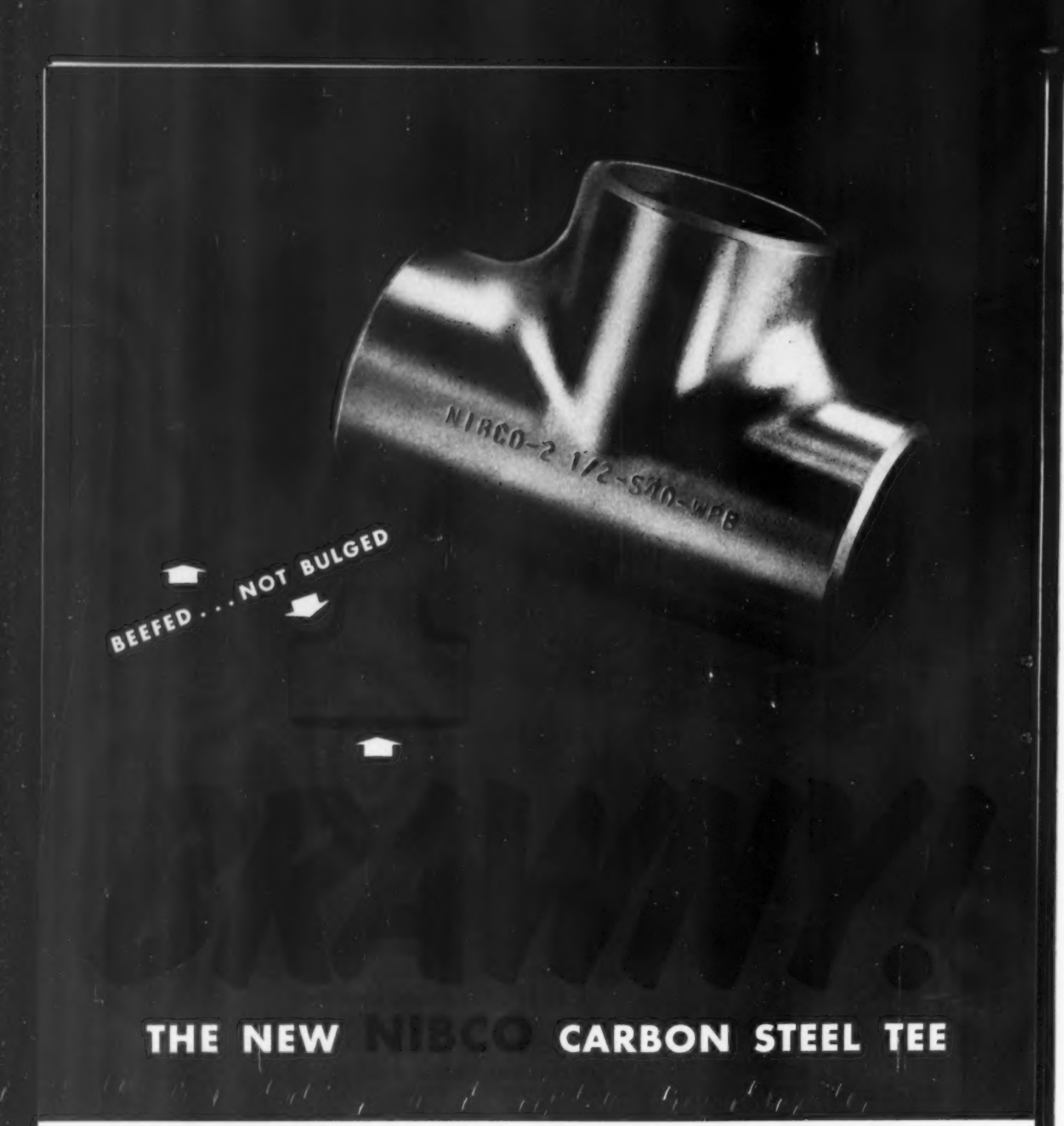
EFCO HEAT TRANSFER EQUIPMENT

● EFCO engineers can supply you with any type of heat transfer equipment to meet your specifications. Reboilers, condensers, atmospheric sections, jacket water coolers, steam generators and heat exchangers, made by EFCO specialists, are sturdily constructed to give long trouble-free service. Ask an EFCO engineer. He will be glad to help you with your heat transfer problems.

ENGINEERS & FABRICATORS, INC.
P. O. Box 7395 Houston 8, Texas

EFCO HEAT TRANSFER EQUIPMENT

For more data on advertised products, use Readers' Service Cards, last page.



THE NEW NIBCO CARBON STEEL TEE

All NIBCO Welding Tees meet A.S.A. Specification B16.9-1940

U.S. PATENTS 2,027,285—2,111,695—2,557,403

NIBCO

Controlled cold-flow of metal makes the NIBCO Tee the strongest point in the pipe line. Walls are reinforced with extra metal thickness where extra strength is needed. NIBCO's exclusive forming operation creates a denser grain structure that makes the tee stronger and more resistant to corrosion. Look for the distinctive "Brawny" shape, the smooth unrestricted passages and the beautiful cold-formed finish. They're your clues to superior performance in NIBCO "Brawny" Carbon Steel Welding Tees. You can get them through your regular source of supply.

NORTHERN INDIANA BRASS COMPANY, 970 Plum St., Elkhart, Indiana

What Suppliers Are Doing . . .

Behr Weight Goode Smith Houston Morrison Voss Miner Weith

Ralph K. Behr, attached to the Chicago district office of **Babcock & Wilcox Company** for the past 17 years, has become manager of the Boston district office of the company's Boiler division, replacing H. K. Dean, who has retired after 31 years of service with the company.

G. H. Weight has been appointed Southwest district manager of B&W's Tubular Products division. Prior to his promotion he was attached to the division's Chicago sales office.

C. Weston Goode, Atlanta, Ga., sales representative for **Gustin-Bacon Manufacturing Company** since 1944, has been appointed district manager for southeastern U. S. He is in charge of the newly opened district office at Atlanta.

H. J. Smith, with Gustin-Bacon since 1949 as representative in Louisville and St. Louis, has been named district manager for the Kansas City Sales division. In this post he will direct sales in Colorado, Wyoming, Nebraska, Kansas, Oklahoma, Arkansas, Texas Panhandle, southern Illinois, western Tennessee and northern Mississippi.

Beverly Houston, who has been associated with **De Laval Steam Turbine Company** for many years in the Accounting department, has been appointed assistant controller.

William Morrison, formerly with Jones & Auerbacher, Inc., and the Newark, N. J., branch of Crane Company, has been appointed sales representative for **The William Powell Company,** Cincinnati, Ohio. He will service industry in the New York area.

George C. Voss, formerly technical sales representative in the Intermediate and Rubber Chemicals department of the Organic Chemicals division of **American Cyanamid Company,** has been named district sales manager with headquarters in New York in the formation of a sales staff for Cyanamid's Petrochemicals department. The new staff, which will be headed by Dr. V. E. Wellman, manager of the department, will handle sales and sales development of acrylonitrile and other industrial chemicals made at the company's Fortier plant at New Orleans, La. The New York sales office will include New York, New Jersey, eastern Pennsylvania and Maryland.

Frank W. Miner, formerly assitant to the manager of the Manufacturers Chemicals department of the Industrial Chemicals division, has been named to the new sales staff of Cyanamid's Petrochemicals department as district sales manager with headquarters in Chicago. The Chicago office will cover Minnesota, Michigan, Illinois, Indiana and Wisconsin.

Dr. A. J. Weith, formerly assistant director of sales of what is now Cyanamid's Petrochemicals department, has been named assistant sales manager of the department.

George W. Brown, executive engineer of **Wagner Electric Corporation,** has been elected a vice president. In this capacity he will have complete charge of Wagner's Engineering and Research divisions, both automotive and electrical, and will also serve as a member of the company's executive committee.

Robert U. Haslanger, until recently director of sales of Monsanto Chemical Company's Plastics division, has been appointed to the administrative staff of **Stauffer Chemical Company.** He will headquarter in the Stauffer New York office.

Howard M. Kirkby, for the past two years eastern sales manager for Clayton Mfg. Company, has been appointed central zone sales supervisor at **American District Steam Company.** He will be responsible for all agency and branch office sales performance in the 18-state territory that comes under his Chicago office.

Frank W. Quiggin, formerly with The Cooper-Bessemer Corporation, has been appointed assistant to the vice president—sales in the Blower-Stoker division of **Read Standard Corporation.** He has been assigned to the division's sales headquarters in New York.

Robert Bader, formerly with the Eastern Sales division, has been appointed sales engineer in Houston for the Welding Fittings division of **Bonney Forge & Tool Works.**

Page Edmunds has been appointed general sales manager of the Petroleum Catalysts department of **Davison Chemical Company** Division of W. R. Grace & Co., succeeding Charles W. Saacke, resigned. Edmunds was formerly assistant sales manager of the Petroleum Catalyst Sales department.

Fred W. Emhardt, formerly assistant manager of the Process Equipment department, has become chief engineer of the Warren division of **Struthers Wells Corporation.**

Charles W. Glunk, sales engineering supervisor at the Mexico, Mo., home office of **A. P. Green Fire Brick Company,** has been appointed district sales manager at the firm's Richmond, Va., sales office. At the same time, Dick Olson was appointed district sales manager of the new Baton Rouge, La., sales office.

Charles T. Everett, formerly with the Aviation division of Bingham-Herbrand Company, has been appointed executive vice president and general manager of **Beaver Pipe Tools, Inc.** He succeeds W. A. Phillis, president, who is to retire soon.

Robertshaw-Fulton Acquires New Plant in Toronto Area

Robertshaw-Fulton Controls Company has announced its new Canadian subsidiary has acquired a modern manufacturing plant in the Toronto area

Brown Haslanger Kirkby Quiggin Bader Edmunds Emhardt Glunk Everett

Suppliers . . .

on a long term lease and plans to start operations late this summer.

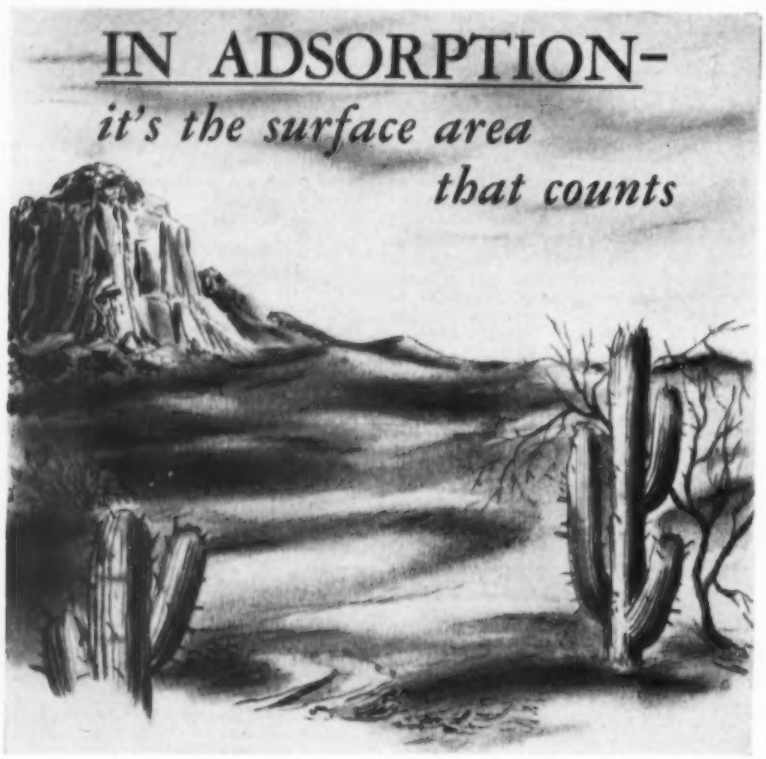
Honeywell Assigns Vorlander To Head British Subsidiary

Edward C. Vorlander has been appointed managing director of Honeywell-Brown, Lt., British subsidiary of Minneapolis Honeywell Regulator Company. Vorlander, who will be headquartered in London, has been with Honeywell 22 years.

Westinghouse Holds Seminar

A week-long industry seminar began August 16 at the Westinghouse Educational Center, Pittsburgh, Pa., for 37 college professors and instructors. Most of the teachers have been working since mid-June at plants of Westinghouse Electric Corporation as part of an annual industrial experience program.

Twenty-three educators from leading U. S. colleges have been assigned to positions in various operating divisions of the company. They will be joined during the seminar by 14 others who will be guests of Westinghouse. Problems of present day engineering developments will be reviewed in panel discussions as part of the seminar.



Dryer than the desert—extremely porous—the multitudinous particles of Florex Fullers Earth possess an adsorptive capacity unequalled by any other known natural material. Consisting of crystals of colloidal size and fibrous shape, Florex assures maximum effectiveness. Florex is so economical that 30 acres of adsorptive surface costs less than a penny.

Florex is particularly superior in the adsorptive refining, decolorization, clarification and neutralization of mineral, vegetable, and animal oils, fats and waxes and for processes involving the use of highly active clay for sweetening light distillates, dehydrations, desulfurization, and polymerization.

Available in all standard particle sizes, special Florex meshes may also be ordered.

Floridin maintains a modern laboratory with highly specialized equipment for the proper evaluation of your adsorption problems. Technical data, samples, quotations, and the services of staff technicians are available upon request.

FLORIDIN COMPANY — **Adsorbents, Desiccants, Diluents**

Dept. E — 220 Liberty Street, Warren, Pa.

Rockwell Appoints Two To Research Department Posts

Former chief engineers of two Rockwell Manufacturing Company divisions

Altorfer

Evans

have been promoted to key posts in two new central research and development departments being established at the company's national headquarter offices in Pittsburgh.

Howard J. Evans, former chief engineer of the Pittsburgh Equitable Meter division, has been promoted to chief engineer and manager of the Central Gas Products Research and Development department.

H. A. Altorfer, former chief engineer of the Nordstrom Valve division, Oakland, Calif., has been named chief engineer and manager of the Central Valve Research and Development department.

Inco Adds Four New Sections To Development and Research

Four new sections have been set up in the Development and Research division of The International Nickel Company, Inc. They are: Constructional Alloy Steels section, with H. V. Beasley in charge; Electroplating section, with Clarence H. Sample in charge; Inco Nickel Alloys Development section, with T. E. Kihlgren in charge; and Stainless Steel and Heat-Resistant Alloys section, with Dr. V. N. Krivobok in charge.

In other changes at Inco, W. Z. Friend has been appointed to succeed F. L. LaQue in charge of the Corrosion Engineering section; Dr. T. P. May and H. T. Paterson have been appointed technical manager and operational manager, respectively, of the "Kure Beach" Corrosion Testing Station near Wilmington, N. C., and W. H. Sparr, Jr., has been appointed to succeed H. V. Beasley in charge of the Technical Field section in Pittsburgh.

Robinson Appoints Snyder

Snyder Company, Houston, has been appointed the Houston and Corpus Christi, Texas, area exclusive representatives for Robinson Orifice Fitting Company's line of products. Snyder has long been active representatives of Robinson in Kansas City, Tulsa, Dallas and Odessa, Texas, territories.

Jack Ribble, formerly with Phillips Petroleum Company, has been appointed manager of Snyder's Houston office.

Sealol to Open New Plant

Relocation of its Providence, R. I., manufacturing operations at a new plant in Warwick, R. I., is planned by Sealol Corporation. The building is now under construction in the new Warwick In-

What it takes to make a 3000 Degree Refractory Concrete

Because of the widespread interest in the use of refractory castables, many furnace operators have asked us for the story behind the performance of B&W's unique refractory concrete, Kaocast.

Here are the answers to some of the most frequently asked questions:

Q. *When you refer to Kaocast as a 3000 degree refractory castable, do you mean that its melting point is 3000° F?*

A. No, this means that its service use limit is 3000° F; its melting point is 200 degrees higher.

Q. *Just what does it take to make a 3000 degree refractory castable like B&W Kaocast?*

A. Let's first define a few terms. Refractory castables are made with granular materials which are volume stable at high temperatures and which can undergo repeated heating and cooling cycles without disintegration. These materials, known as refractory calcines or grogs, are blended with suitable hydraulic binders. The initial strength of a refractory castable is thus developed in the same manner as that of ordinary concrete—that is, through the chemical action between water and the binder. A strong *ceramic bond* is formed when the refractory castable is subjected to temperatures above the vitrification point.

Q. *Then you have a grog, a binder and a method of putting them together. Which is most important?*

A. You can't say that any *one* is most important. It's a combination of all three. Let's take them one at a time. Our grog consists primarily of the proper blend of kaolin and other alumina-silica materials. This ratio enables us to achieve a grog with minimum expansion and shrinkage, a high fusion point, and greater stability under load, at varying temperatures.

Q. *And now, what about the binder?*

A. There are a number of factors responsible for the success of the Kaocast binder. One is the compound Tricalcium Penta-aluminate (3 lime to 5 alumina). This formula produces the most refractory compound (highest melting point) that can be made from lime and alumina. Another is that by using the purest commercially available lime and alumina, the Kaocast binder is substantially free of iron and silica. Such traces of these that are present combine during the pre-firing of the binder to produce stable compounds.

Q. *Just how important is the manufacturing or "blending" of the grog and the binder?*

A. If one factor could be singled out as "most important" it would be quality control.

Direct control over the fineness of materials, prefiring temperatures, and other phases of manufacture is possible at B&W because both the grog and the binder are made and blended at B&W's Augusta Works—under B&W's direct control and supervision.

Q. *These factors you've discussed must add up to some specific advantages of Kaocast. What are they?*

A. B&W Kaocast has all the advantages of easy installation which are responsible for the widespread interest in refractory concretes, plus these exclusive features: It is the only 3000 degree refractory concrete with high resistance to spalling and low volume change throughout its operating range.

THE BABCOCK & WILCOX CO.
Refractories Division
General Offices:
161 East 42nd St., New York 17, N. Y.
Works: Augusta, Ga.

(Advertisement)

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

dustrial Park area and the company expects to move in about mid-November. The new plant will provide 30,000 square feet of space.

Two Reassigned in Changes In Atlas Powder Sales Staff

Two changes in the sales staff of its Chemicals department have been announced by Atlas Powder Company. Arthur G. Heinel, formerly in charge of the Atlanta, Ga., office, has been appointed technical representative in charge of the new sub-office at Richmond, Va. He has been succeeded at Atlanta by Adrian J. Stewart.

Babcock & Wilcox Appoints Severs Development Engineer

E. B. Severs has been appointed development engineer in the Erection department of The Babcock & Wilcox Company's Boiler division. He will be located at the Erection department's headquarters at Barberton, Ohio.

During the past several years Severs has been in charge of the erection of several large central station boiler units in the Pittsburgh and Chicago districts.

Dean Brothers Sets Up Lab

Dean Brothers Pumps, Inc., has installed a new fully equipped pump test and research laboratory at its Indianapolis, Ind., plant.

GLITSCH
LARGE...
OR SMALL . . .
TRAYS
Simple and adaptable in design, GLITSCH "Truss-Type" lightweight trays can be designed for any process requirement with respect to tray size, process layout, type of flow, type and shape of downcomer, weirs, wells, and size and shape bubble caps as well as suitable corrosion resistant materials.
GLITSCH BUBBLE CAPS
Dies for 287 different cap and riser assemblies are now available. The cap styles can be varied further by a wide range of slots. Holddown styles simplify clean-outs, reduce "off-stream" time to a minimum.
Glitsch
FRITZ W. GLITSCH & SONS, INC.
P. O. Box 6227
DALLAS 2, TEXAS
Your engineering staff can effect definite savings in initial designing by utilizing GLITSCH world-wide experience in plans, design and fabrication of tower internals. Cost analyses are available promptly.
SALES OFFICES: New York • Chicago • Cleveland • Houston • Tulsa • Los Angeles

Grove Opens New Office In New Orleans Under Hancock

Opening of new offices at 504 Delta Building, New Orleans, La., has been announced by Grove Regulator Company. W. J. Hancock, formerly of Grove's Corpus Christi, Texas, office, has been appointed district manager in charge of the new office.

Hancock

The company also announced relocation of its Los Angeles office at 1930 West Olympic Boulevard. F. H. Wehrman, district manager, will continue to head this office.

The new moves are part of a company program of adjustment to handle increasing activity growing out of the development of the new Grove gate valve.

Honeywell Division Realigns Sales Divisions and Personnel

A geographical realignment of sales divisions and a number of changes in top sales personnel have been announced by Micro Switch of Freeport, Ill., a division of Minneapolis-Honeywell Regulator Company.

Previously Micro Switch divided the U. S. into four sales divisions, with a division manager in charge of each. Under the new set-up, there will be two sections—eastern and Western—with a sales manager in charge of each.

Emmett N. Hughes, former West Coast division manager, will be western sales manager in charge of all sales operations on the West Coast, including the Rocky Mountain states. He will be headquartered in Los Angeles.

John K. Lincoln will be Eastern sales manager, in charge of sales operations in all states east of the Rocky Mountains. He will headquarter at Freeport. Previously he was Eastern division manager, with headquarters in New York.

Anderson Wacaser, former Central division manager with headquarters in Cleveland, will be transferred to Micro Switch's home office to head the Market Research, a new section in the sales department.

Shell Chemical Forms New Resins Sales Group

Formation of a specialized resins sales group to expand structural applications of its line of epoxy resins has been announced by Shell Chemical Corporation.

Five senior technical salesmen—R. L. Hallam, Detroit; F. C. Herot, Cleveland; W. A. Hubbard, Chicago; G. F. Metzinger, Newark, N. J.; and D. M. Neely, New York—are the initial members of the new sales group. They recently completed an intensive six-week training program at the company's laboratory at Union, N. J.

Selas Expands Field Sales

In an expansion of its field sales organization, Selas Corporation has formed a new St. Louis sales zone

NEW speed...accuracy...dependability...

in the measurement of percentage hydrogen

in liquid hydrocarbons

THE NEW Cenco® BETA RAY $^{H}/_{C}$ METER

utilizes radioisotopes

Here is a practical, efficient precision instrument designed for use in research as well as in product control and routine analysis. It provides a fast, accurate means of measuring the percentage of hydrogen, or the hydrogen-carbon ratio, in liquid hydrocarbons.

- ★ Makes complete determination in 5 minutes
- ★ Accurate to within 0.02 weight percent hydrogen
- ★ Handles hydrocarbons ranging from normal pentane to 1.6-dimethylnaphthalene with no change in precision over the full range
- ★ Calibration is independent of pressure changes in ionization chambers since they share a common supply of gas
- ★ Temperature changes do not affect measurement since both specific gravity and beta absorption measurements are made automatically at same temperature
- ★ Twin beam instrument using single beta ray source is independent of source variations
- ★ Adequate shielding makes instrument safe from radiation hazards
- ★ Null-point balance is independent of electrometer variations

The New Cenco Beta Ray H/C Meter fills a long felt need in numerous petroleum processing operations . . . where the hydrogen-carbon ratio is altered . . . where the percentage of hydrogen is an index to the performance of end products such as jet fuels, fuel oils, gasolines, etc. Our Bulletin No. 115 contains full details about this precision instrument. Write for your copy today.

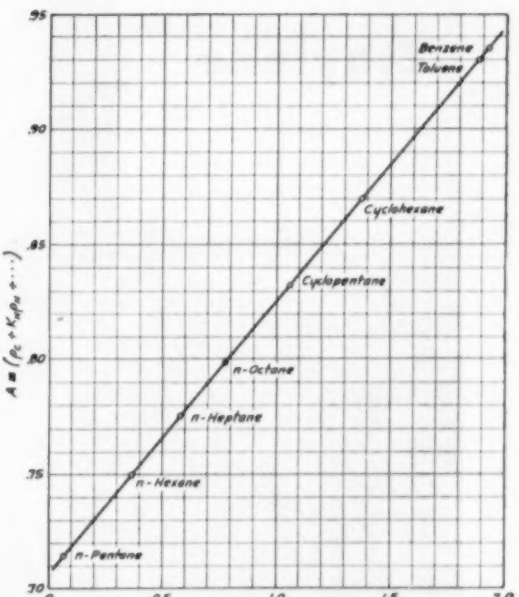


Fig 8. Typical Calibration Curve

Exclusive manufacturing and sales rights for the Cenco Beta Ray H/C Meter have been assigned to Central Scientific Company by Standard Oil Company (Indiana).

cenco

The most complete line of scientific instruments and laboratory supplies in the world

R.S.G.

CENTRAL SCIENTIFIC COMPANY

MAIN OFFICE — PLANT — CENCO INTERNATIONAL CIA.
1700 IRVING PARK ROAD • CHICAGO 13, ILLINOIS

BRANCHES AND OFFICES — CHICAGO NEWARK BOSTON WASHINGTON DETROIT SAN FRANCISCO SANTA CLARA LOS ANGELES

CENTRAL SCIENTIFIC CO. OF CANADA, LTD. (and Hendry Division)
TORONTO MONTREAL VANCOUVER OTTAWA

REFINERY SUPPLY COMPANY — TULSA HOUSTON

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

under Robert W. Breckenridge, who has been in a sales engineering capacity for Selas for the past seven years.

U.S. Steel Division Names Manager of Process Pump Sales

E. W. Johnson has been appointed manager of process pump sales for United States Steel Corporation's Oil Well Supply Division and will make his headquarters at Dallas, Texas.

Johnson joined "Oilwell" in October, 1950. Since August, 1953, he has been consultant on centrifugal pumps at Dallas.

American District Steam Adds New Plant at North Tonawanda

A new $800,000 plant and expansion program have been completed at the North Tonawanda, N. Y., plant of American District Steam Company, Inc. The company used the occasion of the completion to report on the healthy growth of the company in the past nine years.

Electric Steel Foundry Moves

The San Francisco branch of Electric Steel Foundry has recently moved its sales office and warehouse to larger quarters in Emeryville, Calif.

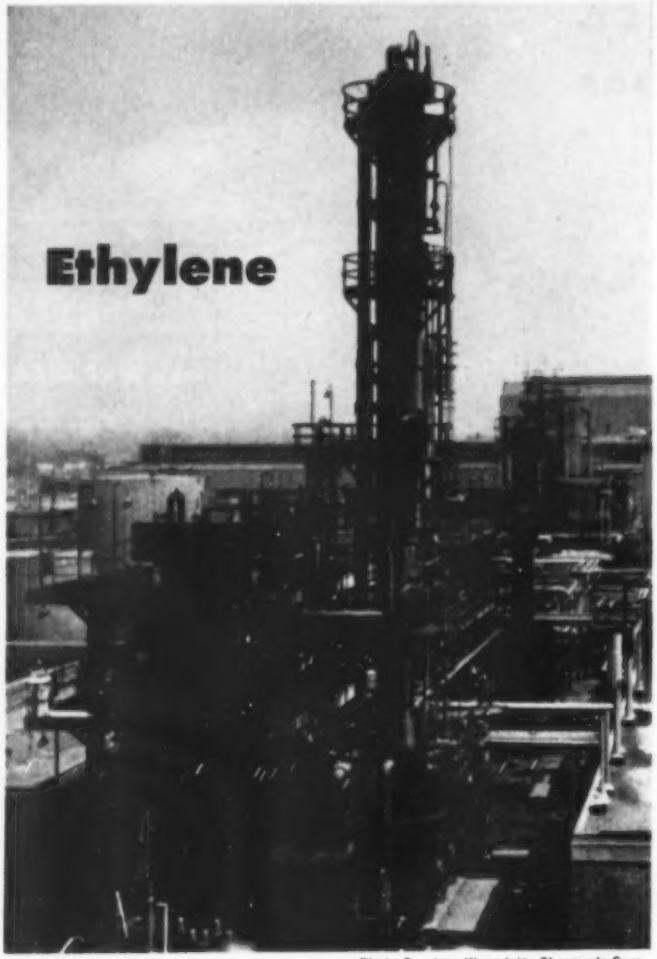


Photo Courtesy Wyandotte Chemicals Corp.

Low Temperature Ethylene Recovery Unit

Designed and Engineered by

THE C. W. NOFSINGER CO.

Engineers and Contractors for the Petroleum and Chemical Industries

906 GRAND AVENUE KANSAS CITY 6, MISSOURI

Grove Regulator Adds Five to Sales Staff in Houston Area

Appointment of five additional men to its Houston area sales engineering staff has been announced by Grove Regulator Company. The appointees will serve expanding markets for the firm's new gate valves. All will make their headquarters at the Grove offices in Houston.

Bradford Hulsey

Hicks Nerren Wright

Serving as assistant division sales manager is J. D. Hicks, who was district manager for the firm's Corpus Christi office during the past several years.

Paul Nerren, before joining the Grove organization, served for 20 years with a nationally known valve manufacturer.

C. B. Wright, Jr., prior to joining the Grove sales engineering staff, specialized for many years in oil and gas production equipment.

Eldon E. Hulsey, with 20 years of experience in the Gulf Coast, Northern Louisiana and Mid-Continent areas, was for 13 years with the refining and pipeline division of a well-known oil company.

F. J. Bradford is known throughout the Mid-Continent and Gulf Coast areas for his sales experience in oil field equipment during the past two decades.

Clark Equipment Revamps Executive Responsibilities

Executive responsibilities have been realigned in the Automotive division and the Industrial Truck division of Clark Equipment Company.

Under the new arrangement, Charles H. King, vice president formerly in charge of manufacturing operations, will direct the Automotive division, including product development, engineering, manufacturing, sales and service functions. E. M. Schultheis, vice president formerly in charge of Automotive division sales, will serve as a consultant to the president.

Robert H. Davies, vice president formerly in charge of industrial truck production and engineering, will direct the Industrial Truck division functions. W. E. Schirmer, vice president formerly in

Holding SAFETY MEETINGS *Regularly*

What **POLICYHOLDERS** *Say*

This is one of many testimonial letters received from policyholders of the Texas Employers Insurance Association. These letters tell what policyholders think of the Service and Savings received from the Association.

Ask the Texas Employers representative nearest you to show you more of these letters, as proof of what Texas' largest writer of Workmen's Compensation Insurance can do for you.

40TH ANNIVERSARY 1914-1954

WE QUOTE FROM A POLICYHOLDER'S LETTER

"We have today received your dividend check for $20,813.23. This check plus our guaranteed cost discount which we have already deducted represents a total savings of 65.69% of our workmen's compensation insurance premiums for the past year.

"Our losses for the year amounted to only 4.31% of our premiums. This is by far the best year we have ever had from the standpoint of the number and cost of accidents sustained. You will recall that we installed a comprehensive safety program at the time you wrote this policy and our employees have diligently maintained this program in effect. Our drilling rigs and our plant are regularly holding safety meetings and we attribute much of our success to these meetings. We feel that the savings in payroll cost and increased efficiency more than offset the time spent on the safety program.

"We heartily recommend a safety program to any contractor in the oil industry."

Largest Writer of **WORKMEN'S COMPENSATION INSURANCE** *in Texas*

HOMER R. MITCHELL, *Chairman of the Board* A. F. ALLEN, *President*

Service Offices: ABILENE • AMARILLO • AUSTIN • BEAUMONT • CORPUS CHRISTI • DALLAS • EL PASO FORT WORTH • FREEPORT • GALVESTON • HARLINGEN • HOUSTON • LUBBOCK • MIDLAND ODESSA • PORT ARTHUR • SAN ANGELO • SAN ANTONIO • SHERMAN • TYLER • WACO • WICHITA FALLS

TEXAS EMPLOYERS INSURANCE ASSOCIATION
HOME OFFICE - DALLAS, TEXAS

For more data on advertised products, use Readers' Service Cards, last page.

Depend on LADISH

To Meet All Your Fittings Needs With an Unsurpassed Range of Sizes and Materials

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1 BUTT WELDING FITTINGS

2 A.S.A. FORGED FLANGES

3 FORGED SCREWED OR SOCKET WELDING FITTINGS

4 T.E.M.A. HUB & RING FLANGES

5 LONG WELDING NECKS

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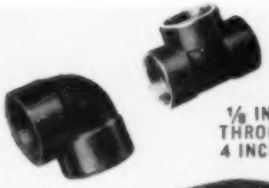
Available in...

Complete Service . . .

½ INCH THROUGH 42 INCHES

½ INCH THROUGH 24 INCHES



⅛ INCH THROUGH 4 INCHES

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CARBON, STAINLESS AND ALLOY STEELS, ALUMINUM, NICKEL AND OTHER FERROUS AND NON-FERROUS METALS

To Meet Your Entire Fittings Needs with a Line Complete In All 6 Major Types

For dependable service that results from an ideal combination of broad line and ample stock . . . specify and buy LADISH . . . the Controlled Quality line that offers a complete range of sizes, types, weights, pressure ratings and materials needed for virtually any piping installation. Your local Ladish distributor's ample stock is backed by complete factory inventories to keep your piping jobs on schedule. So, for *complete service* in fittings . . . specify and buy LADISH.

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PRODUCED TO ONE STANDARD OF UNSURPASSED QUALITY

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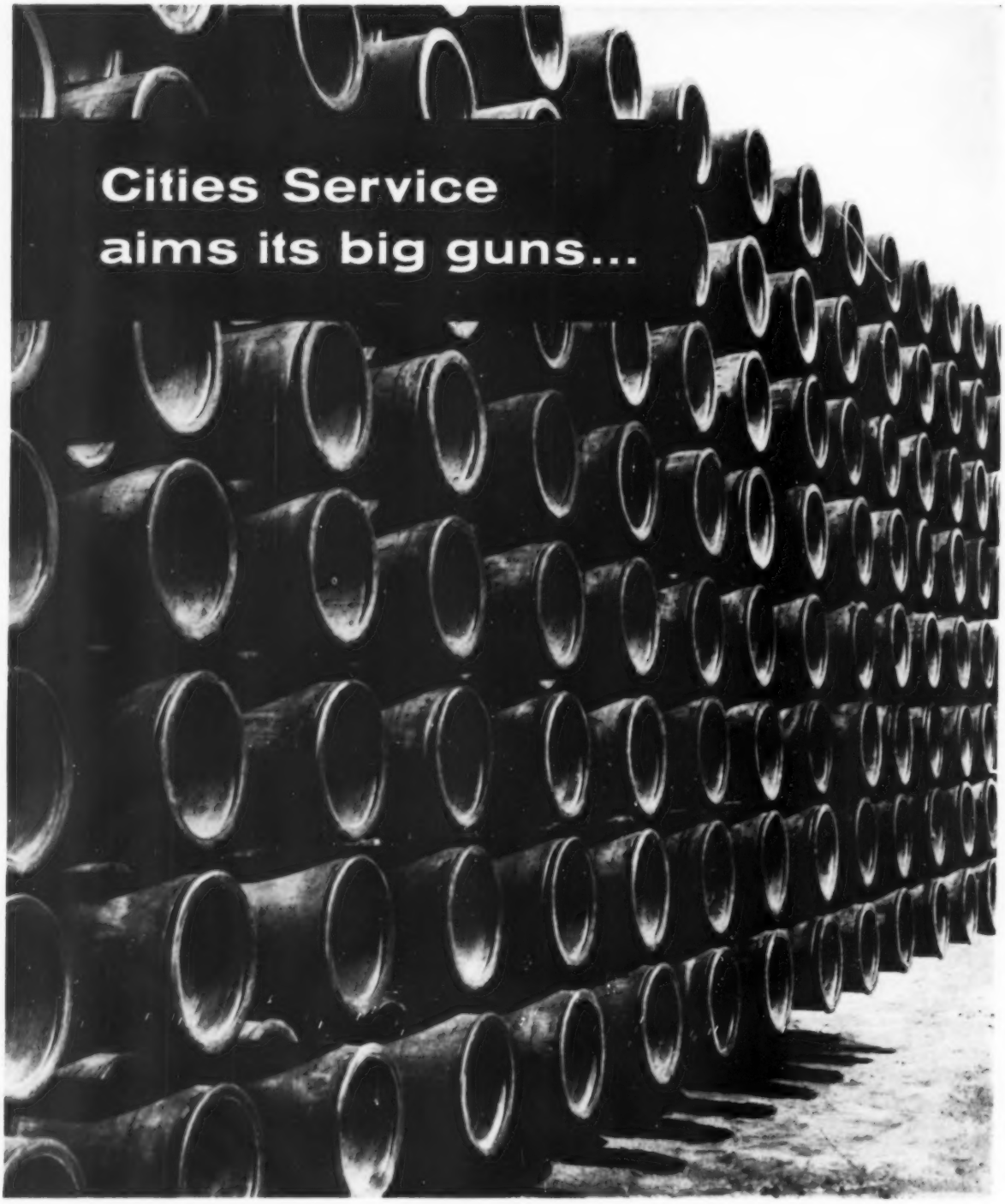

Acres of casing are mobilized in readiness at a well site. Last year an average of 1⅓ producing wells were drilled every day by

CITIES SERVICE

A Growth Company

Reynolds Ups Ore-Processing Capacity—

Across the Bay from Corpus Christi, Texas, Reynolds Metals Company has built and started operating two new industrial plants. One, the San Patricio reduction plant, in the background, produces metallic aluminum a half-mile inshore; the other, the La Quinta Alumina plant, in the foreground, extends to the water's edge. The entire site covers 1700 acres. The Texas Gulf Coast offers the operation a ready supply of natural gas, 60 Mmcf of which the plants will consume each day, and is close to rich Caribbean bauxite deposits.

charge of the division's sales, will handle special projects on management planning, market research and other corporate matters.

Clark Adds 19 Dealers

Nineteen new dealers have been appointed to sell and service the Michigan line of excavator cranes and tractor shovels, products of the Construction Machinery division of Clark Equipment Company.

Suppliers . . .

Company Changes

A. L. Woods has been appointed assistant to the vice president of metal sales and procurement of **Calumet & Hecla, Inc.** His new assignment is in addition to his responsibilities as director of purchases of the firm's Wolverine Tube division . . . **George E. Kemper,** until recently manager of the LPG division of **A. O. Smith Corporation,** has been appointed general manager of the corporation's Welding Products division, and will transfer from Houston to Milwaukee . . . **W. D. Morrison,** for the last two years assistant manager of the Product Development department of the Chemical division, has been named assistant to the director of the Development department of **Celanese Corporation of America** . . . **R. B. (Bob) Grant,** formerly regional industrial manager for the Pacific region, has been named Los Angeles branch manager for **Minneapolis-Honeywell Regulator Company.**

J. Louis Irwin, formerly manager of labor relations, has been promoted to director of the Industrial Relations division of **Lukens Steel Company,** succeeding William C. Robinson, who is resigning because of a health condition. Thomas J. Ryan, formerly assistant manager of labor relations, takes Irwin's

WIRE-MESH PRODUCTS

for all filtering and straining applications.
All meshes, all weaves, all alloys.

Send Specifications for an estimate.
Department 16

THE C. O. JELLIFF
MANUFACTURING CORP. SOUTHPORT CONN.

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PLUGS & RECEPTACLES
The Safe Way to Make Electrical Connection of Portable Equipment.
NON-SPARKING.
Even when improperly sealed. Safety Time Delay.
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Alumalloy Construction. Rust and corrosion proof. Complete variety of sizes and styles.
Killark
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For more data on advertised products, use Readers' Service Cards, last page.

CENTERLESS GRINDING

Turns Out
Smoothest of **THREADS**
on **KILBOURN-Processed**
ALLOY STEEL BOLT STUDS
AT NO ADDITIONAL COST

- Made from heat-treated bars — (A.S.T.M. A193 Grade B-7)
- *Centerless-ground* for smooth finish — not obtainable with most other production methods.
- Far less tendency to seize during assembly or disassembly.
- Preferred by refineries, chemical plants, power plants, pipeline installations.

Write for Bulletin

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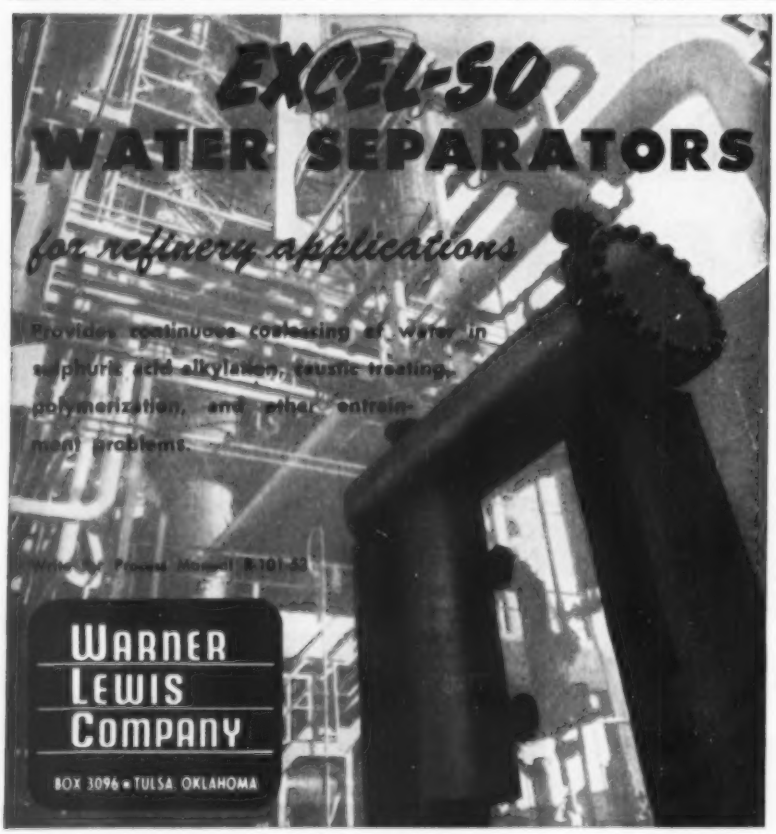
STUDS • THREADED BARS • STILL SCREWS • STAINLESS STUDS AND NUTS



Suppliers . . .

old post . . . **Alexander E. Walker,** board chairman and director of National Supply Company, has been elected a director of **Blaw-Knox Company** . . . **V. H. Boden** and **D. B. Mullin** have been appointed assistant sales managers of the Industrial Chemicals Sales department of **Carbide and Carbon Chemicals Company,** a division of Union Carbide and Carbon Chemicals Company. Boden will continue to supervise the operations of the Eastern division from his Philadelphia offices, while Mullin will be responsible for all the staff operations of the Industrial Chemicals Sales department.

John H. Pettit, of Gardenvale, Quebec, has been appointed sales agent in eastern Canada for the Alloy Tube division of **The Carpenter Steel Company,** Union, N. J. . . . **F. D. Krusemark,** formerly assigned to the Denver district office, has become resident engineer with headquarters at Dallas, Texas, of **Bailey Meter Company,** Cleveland . . . **Edward C. Vorlander,** who has been with Minneapolis-Honeywell Regulator Company 22 years, has been appointed managing director of **Honeywell-Brown, Ltd.,** British subsidiary of the company. He will be headquartered in London. V. E. MacLachlan continues as director and general manager of the British firm.

L. John May, formerly with Allied Chemical & Dye Corporation, has become plant manager at **National Foam System, Inc.,** of West Chester, Pa . . . **John Lawrence,** formerly vice president of manufacturing and engineering, has been elected executive vice president of **Joy Manufacturing Company,** Pittsburgh . . . **Bernard F. Shema,** formerly a member of the research and teaching staff at the Institute of Paper Chemistry, Appleton, Wis., has joined the staff of **W. H. & L. D. Betz** as chief microbiologist.

Harper Becomes President In Franklin Supply Elections

New officers recently elected to serve for the forthcoming year at Franklin Supply Company are as follows: Jene Harper, president; Roy Wood, Leland Strouse, and Lawrence Harper, vice presidents; Albert J. Mitchell, treasurer, and William P. Quan, secretary.

At the annual board meeting at which officers were elected, decision was made to establish two new oil field supply stores, one at Fort Morgan, Colo., the other at Newcastle, Wyo. The board also approved the appointment of William Kerin to the newly created post of general store manager. Kerin's former position as store manager at Oklahoma City has been filled by Jack Carroll.

Franklin Supply also announced that Franklin Pipe and Supply, Ltd., its Canadian subsidiary, has opened a sales office at Calgary, Alta.

U. S. Steel Division Appoints Houston City Representative

Harold C. Nicholson, who has held various sales and managerial positions since joining the Oil Well Supply Division of United States Steel Corporation in 1946, has been appointed city representative at Houston for the division.

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

Cooper-Bessemer Promotes Gallogly to Chief Engineer

Dennis L. Gallogly has been appointed chief engineer of the Product division of The Cooper-Bessemer Corporation, Mount Vernon, Ohio. He replaces Robert F. Lay, recently advanced to assistant general sales manager of the corporation.

Gallogly

Gallogly had been service manager of the Mount Vernon plant.

Several personnel changes for his division have been made by Gallogly. These concern the Service, Application Engineering and Manufacturing Liaison departments.

Samuel F. Lamb has become service manager, succeeding Gallogly. Richard F. Kymer has become manager of application engineering, and Edward D. Newell assistant manager of application engineering. Ellsworth L. Lerch is now manager of the Manufacturing Liaison department, and John Konkler has succeeded Lerch as resident engineer at the Grove City plant.

Westinghouse Reassigns Osborne, Lynde to New Posts

Latham E. Osborne, formerly executive vice president—defense products at Westinghouse Electric Corporation, has been appointed executive vice president. At the same time he was elected to the company's board of directors.

Leslie E. Lynde, vice president in charge of the Aviation Gas Turbine division at South Philadelphia, Pa., will succeed Osborne. Lynde's successor will be named later.

Osborne joined Westinghouse in 1910, was appointed executive vice president in charge of defense products in 1951. Lynde has been with the company since 1920, has served in the Boston office and the Washington, D. C., office. He was assigned responsibility for the Aviation Gas Turbine division in April, 1953.

Hosmer Replaces Belin as Monsanto Division Plant Head

Desmond B. Hosmer has been named manager of the Anniston, Ala., plant of Monsanto Chemical Company's Organic Chemicals division.

At the same time, Wallace K. Belin, whom Hosmer replaces, will become production manager of the Monsanto plant now under construction at Kearny, N. J.

Hosmer was formerly assistant plant manager of Monsanto's W. G. Krummrich plant. Belin has been manager at Anniston since January, 1954.

Universal Atlas Names Graves

Ray Graves, plant engineer at the Waco, Texas, plant since 1945, has been appointed assistant to the general oper-

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At left: Jacketed 3-Way Plug Cock.

Below: Cutaway section of Jacketed Cock, showing packing gland construction.

Jacketed Pipe, Pumps, Valves and Fittings . . .

Jacketed Meter, with set-back register, for measuring viscous liquids.

for maintaining uniform temperatures (hot or cold) in process pipes

Regardless of whether the material is being heated or cooled in the processing, and what heating or cooling medium is being used, H & B jacketed fittings are available for all applications. Steam, hot water or hot oil may be used for heating, cold water or brine for cooling.

H & B can save you money on your jacketed pipe and fitting requirements because we buy all standard size pipe from the mill in carload lots, make our own special flanges in quantities, and are tooled up for making jacketed equipment at lowest possible price. Write for Bulletin J-50.

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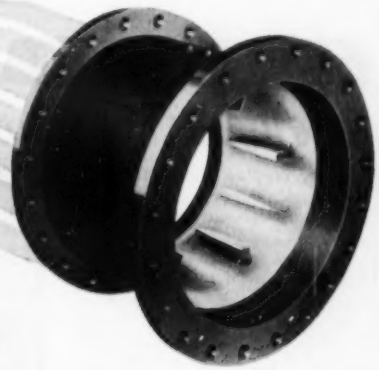
FOR *LOWEST* HEAD LOSS IN FLUID METERING



The *Gentile FLOW TUBE**

*GEN-TIL'LY

WHERE HEAD LOSS IS IMPORTANT . . . The Gentile Flow Tube can be designed to produce a measurable differential with the lowest permanent pressure loss of any head meter.

ACCURACY . . . Differential is produced from points of equal cross-sectional area. Furnished with head capacity curves, and guaranteed for exceptional accuracy when used with any standard indicating, recording or integrating meter.

REVERSIBILITY . . . When the flow is reversed, the differential is reversed. Permits metering reverse flow at lowest possible equipment cost.

LOW INSTALLED COST . . . Average length is only 1½ times the pipe diameter, and straight runs entering and following are not required unless installed near throttling valves or regulators.

Write for Bulletin FT-101 or specific recommendations.

FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE UNION, N. J.

AUTOMATIC VALVES • SAFETY VALVES • FLOW TUBES

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

ating manager of Universal Atlas Cement Company, a subsidiary of United States Steel Corporation.

Climax Expands Detroit Lab In New Research Program

A quarter million dollar expansion of its Detroit laboratories has been announced by Climax Molybdenum Company as part of a new research program in molybdenum chemicals.

The new chemical program will be devoted mainly to research in molybdenum catalysts for upgrading low octane gasolines, in the synthesis of new molybdenum chemicals. To house the new research program, the company has acquired a modern building adjacent to the present Climax laboratories in Detroit.

Three Sales Representatives Added at Jefferson Chemical

Jefferson Chemical Company, Inc., has announced the following appointments to its staff of sales representatives: George Kahl, formerly with McGraw Hill; Claude Harvey, formerly with Heyden Chemical Corporation, and Edward Lasek, formerly with Keiding Paper Products.

Edward Birkett, formerly with Mathieson Chemical, has joined Jefferson's Commercial Research division.

U.S. Steel Appoints Rohl as Chief Metallurgical Engineer

L. J. Rohl has been appointed to the newly created position of chief metallurgical engineer of United States Steel Corporation. In this capacity he will coordinate the metallurgical activities of all divisions of U. S. Steel.

Simon

Rohl

Rohl was formerly chief metallurgical engineer, operations—steel, and has been succeeded in this post by R. W. Simon, who has been serving as assistant chief metallurgical engineer, operations—steel.

AAF Buys Appliance Plant

The entire plant and equipment of Ice Cooling Appliance Corporation, Morrison, Ill., manufacturers of ice refrigerators, freezers, soft drink coolers and vending machine parts, have been purchased by American Air Filter Co.

The 152,000-square-foot Morrison plant will be operated by AAF's Herman Nelson division.

General Electric Will Show New Water Pollution Film

A new version of "Clean Waters," a film calling attention to pollution of water resources, will be premiered by General Electric Company at the annual meeting of the Federation of Sewage and Industrial Wastes Association in Cincinnati, October 10 through 14.

Latest in the company's More Power to America series, the 25-minute, full-color, sound motion picture is designed to create an awareness to the growing of stream pollution and to enlist public and industry support for programs geared to meet the problem.

New Rockwell Testing Station Starts Up Near Pittsburgh

The world's largest meter and valve testing station built expressly for testing meters and valves under actual operating conditions has been opened on the outskirts of Pittsburgh by Rockwell Manufacturing Company.

Occupying about an acre of a four-acre plot owned by the company, the new station consists of two aluminum-sheathed one-story buildings, a row of petroleum storage tanks, a bulk station loading rack and more than a half a mile of above-ground piping.

Newburn Becomes President Of Air Reduction Canada

S. H. Newburn has been appointed president of Air Reduction Canada, Ltd. Since 1950 he had been regional manager

DOLLINGER DELIVERS

HIGH UNIT AT LOW COST

Piercing the mid-western sky with its giant steel members, this refinery unit was erected at an economical cost. The savings were effected in large measure by Dollinger's exacting accuracy in the fabrication of the steel members and details.

Designed and erected by the Fluor Corporation LTD, this refinery unit is another example of Dollinger's ability to produce fabricated structural steel —accurately and dependably.

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AROUND THE WORLD

For more than 50 years quality producers of structural steel and plate steel.

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USE THIS NEW SAFETY MATERIAL ALL OVER YOUR PLANT

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Flooring

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Partitions

Safety GRIP-STRUT Pat. Pending

NON-SKID—RUGGED—LOW COST

Safety Grip-Strut is a new basic material. All one piece, steel or aluminum, in various sizes and gauges. Sold like lumber, used like lumber and stocked in your storeroom like lumber. Ideal for on-the-job fabricating. Not welded, riveted or expanded. It presents an open space, in a diamond shaped pattern, in excess of 75% of the area for ready access of light and air and gives a positive NON-SKID footing in all directions. Ideal for stair treads, fire escapes, cable trays, work platforms, catwalks, flooring and for original equipment safety treads. Your own mechanics can install it—it's inexpensive, yet permanent and safe.

Write today for new catalog showing loadings and methods of easy application in your plant.

Distributors in all principal cities.

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Manufacturers since 1914
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A beautiful picture...OF TROUBLE

Photomicrograph by J. G. Suthard

The above photomicrograph shows salt crystals in crude oil, magnified to seventy times actual size. When salts such as these get into refinery equipment, the picture isn't so pretty. Salts in the crude charge invariably result in a substantial decrease in refining efficiency. The only protection against them is effective desalting. You get it, with

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ELECTRIC DESALTING

DS4-1

The photomicrograph on the reverse of this page was made as a routine step in Petreco's never-ending study of salts in crude oil and their effects on refining operations. When you consider the merits of a desalting process, it is well to give considerable thought to the calibre of the organization offering the process. Petreco pioneered electric desalting and can back Petreco processing with the know-how resulting from nearly half a century of electric processing experience.

Petreco desalters guard your refinery, day and night, against shutdowns caused by salts, solids and BSandW in the crude charge. You can't get better protection, because you can't get better desalting.

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SEDIMENT SEPARATING
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Pt. Arthur: Oliver Wagner, Ph. 2-8320

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VENEZUELA
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D54-1

of the North Central region of Air Reduction Sales Company with offices in Chicago. D. F. McCandlish, Chicago district manager, succeeds him in that post.

Rochester Manufacturing Adds New Executive Vice President

Allen H. Ottman has been elected executive vice president and general manager of Rochester Manufacturing Company. He will also serve as a director.

Ottman

Other officers of the company, Clark L. Hasting, vice president in charge of sales and engineering, and Warren W. Hastings, secretary and director of manufacturing operations, will continue in their present capacities, according to William Mulcahy, president.

During the last nine years, Ottman has served as controller and later as vice president and a director of American Hard Rubber Company.

FMC Buys Chicago Pump; To Become Peerless Component

Chicago Pump Company has been purchased by Food Machinery and Chemical Corporation. FMC anounced that Chicago Pump was acquired to complement FMC's regular lines of Peerless industrial and agricultural pumps with a line of specialized equipment in the waste disposal and building fields.

As a subsidiary of FMC, Chicago Pump will be an operational component of the parent corporation's Peerless Pump division. It will continue to operate under the direct management of George D. Bers, president of Chicago Pump, and Milton Spiegel, vice president and general manager.

H. S. Graver, Last Son of Graver Firm Founder, Dies

H. S. Graver, Sr., product manager of the Bulk Tank divisison of Graver Tank & Mfg. Co., Inc., died August 6 in Chicago following a heart attack. He was the last remaining son of the company's founder and had just completed fifty years of service. He was 64.

Banks Moreland Dies

Banks G. Moreland, vice president and director of Graver Tank & Mfg. Co., East Chicago, Ind., and manager of Graver's Banks Moreland division in Houston, died recently at his home in Houston. Though a native of Louisiana, Moreland spent most of his lifetime in Texas and was one of the best known men in the steel fabricating industry in the Southwest.

Chicago Bridge Chairman Dies

Merle J. Trees, 71, chairman of the board of Chicago Bridge & Iron Company, died August 6 in Chicago. Trees started as an estimator and contractor for Chicago Bridge in 1910, and, in 1945, was made chairman of the board.

Lunkenheimer Chief Engineer Completes 50 Years Service

Fred H. Hehemann, one of the oldest employes of Lunkenheimer Company, recently observed his fiftieth anniversary with the company. He has taken an active part in the development and growth of the company since joining it in 1904. He has been chief engineer since 1945.

Diamond Alkali Adds Rieger

George Rieger has been named to lead and coordinate market research activities of the recently formed Commercial Development department of Diamond Alkali Company, Cleveland.

Rieger was formerly with Hercules Powder Company, where he was assistant manager of the Sales Research division.

Suppliers . . .

Clark Equipment Starts Work On New Manufacturing Plant

Clark Equipment Company has announced the start of steel erection for its new manufacturing plant on a 100-acre tract of land on the outskirts of Benton Harbor, Mich. The Austin Company, engineers and builders, has been awarded the contract for design, engineering and construction of the new unit. It will have 145,000 square feet of floor space.

At the same time the company announced the establishment of a "Ross Carrier Division" for its Ross line of straddle carriers. A. H. Pierce, who has had broad experience with the company, has been selected as division manager. Roger Spencer will continue as chief

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SCIENTIFIC LABORATORY EQUIPMENT & FURNITURE

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CENTER TABLES
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METALAB equipment is superior — a fact that is universally recognized. Equally important is the integration and coordination of the respective units into a well-designed, functional and complete assembly. The end result must be the most and best for your laboratory budget dollars. The most successful approach to this type of installation is to avail yourself of METALAB's Engineering and Planning Service at no obligation.

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For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

engineer for the Ross Carrier line, and Jack W. Ross will supervise sales information activities for the new division.

Central Scientific's Long Studies Radioisotopes Use

Walter L. Long, education service manager of Central Scientific Company, Chicago, has completed a two-week course in the use of radioisotopes in secondary school science teaching at the Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn. He studied methods of using "tracer atoms" in classroom demonstrations and laboratory teaching.

Illinois Engineering Elects Pickett Vice President

C. A. Pickett has been elected vice president of Illinois Engineering Company, Chicago. He has served as general manager of Illinois Engineering since the company was acquired by American Air Filter Company, Inc., in 1953.

John Hellstrom, vice president and director of sales of AAF, and Pickett were also elected directors of Illinois Engineering.

Atlantic Appoints Arasim

The Atlantic Refining Company has appointed Stanley Arasim, Jr., market and product development specialist in chemical product sales. He is a graduate chemical engineer of Lafayette College.

Albert Phillips To Manage BS&B Pricing and Estimating

Albert B. Phillips, vice president and general manager of Panhandle Steel Products Company, Inc., Wichita Falls, Texas, since 1951, has been appointed manager of pricing and estimating at Black, Sivalls & Bryson, Inc. He will be in charge of this operation for the entire company and will make his headquarters at the Kansas City office.

Phillips

In his 15 years of experience in steel fabricating, Phillips has been associated with Fabricators, Inc., of Velasco, Texas, George E. Little & Associates, Houston, and Lockwood & Andrews, Engineers, of Houston. Before his promotion to vice president and general manager of Panhandle, he served that company as chief estimator and chief engineer.

Three Executives Promoted in Elections at Universal Atlas

In elections at Universal Atlas Cement Company, Fred T. Wiggins has taken over the newly created office of vice president—commercial; James C. McClure has become vice president and general sales manager, and Henry C. Schmielau, currently comptroller, has assumed the additional duties of vice president.

At the same time Mac H. Hull was appointed assistant to the president, and W. Owen Lawrence was made general operating manager.

Universal Atlas is a subsidiary of United States Steel Corporation.

Wiggins has been a vice president and general sales manager of the company since 1951; McClure, an assistant vice president in New York since 1952; Hull, an assistant vice president since 1952; and Lawrence, manager of the company's Buffington, Ind., plant since 1949.

Cyanamid Assigns Milionis To New Product Development

Dr. J. P. Milionis has joined the New Product Development department of American Cyanamid Company. In the post he will introduce new Cyanamid products to the chemical industry and will be concerned with general development projects. He has served in Cyanamid's Stanford Research Laboratories since 1951 as a research chemist.

Metallizing Engineering Will Build New Plant at Westbury

Plans for a new "garden type" plant at Westbury, Long Island, N. Y., have been announced by Metallizing Engineering Company, Inc. The new building, designed by Brown and Matthews, Inc., is scheduled for completion July 31, 1954, and will occupy 65,000 square feet of space. It will include over 20,000 square feet of office space in addition to 45,000 square feet of manufacturing, storage and shipping areas, all located on a single floor. The building will be con-

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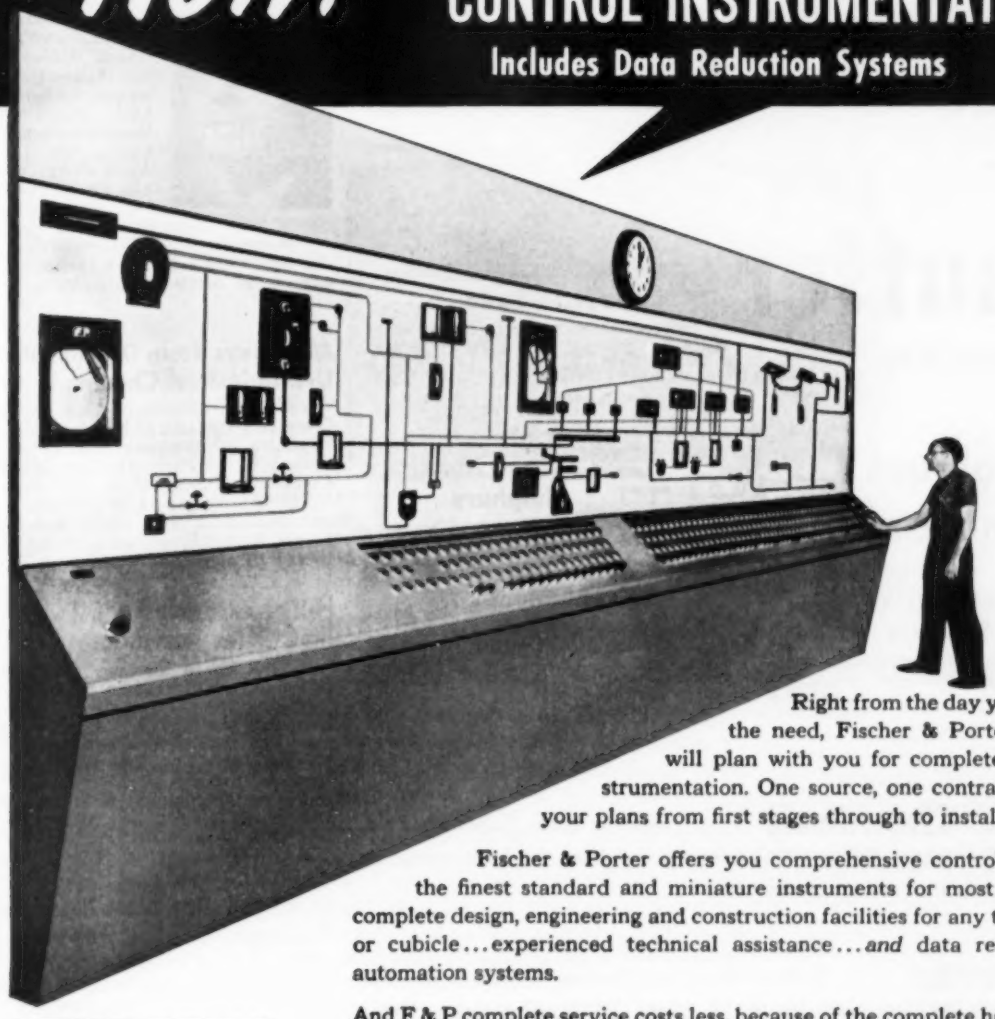
NOW! FISCHER & PORTER'S COMPLETE CENTRALIZED CONTROL INSTRUMENTATION

Includes Data Reduction Systems

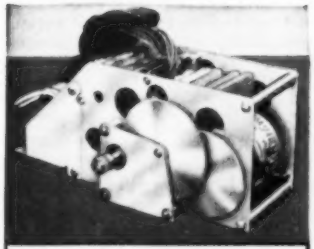


Right from the day you recognize the need, Fischer & Porter Company will plan with you for complete process instrumentation. One source, one contract—will take your plans from first stages through to installation.

Fischer & Porter offers you comprehensive control coverage—the finest standard and miniature instruments for most variables... complete design, engineering and construction facilities for any type of panel or cubicle... experienced technical assistance... *and* data reduction and automation systems.

And F & P complete service costs less, because of the complete handling from beginning to end in one plant.

Use all the advantages of automation. Write, call or wire today for complete information and engineering assistance.



F & P is first with a Data Reduction and Automation Division. Now available is a new digital converter, which provides completely automatic logging from sensing elements to coded or tabulated digital data output.

LA-1004

complete process instrumentation

FISCHER & PORTER CO.

994 County Line Road, Hatboro, Penn.

FP

Measuring, Recording, and controlling instruments—Control Panels—Data Reduction Systems—Contract Instrumentation Research—Chlorination Equipment—Glass Specialties.

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

structed of brick masonry, steel and glass, and will be sprinklered.

Pyle-National Adds Two To Hike Board Members to Seven

Membership of the board of directors of Pyle-National Company, Chicago, has been increased from five to seven. John D. Ames, of Chicago, a partner in Bacon, Whipple & Company, and former publisher of The Journal of Commerce, and Harold B. Spackman, president of Lyon Metal Products Company, Aurora, Ill., were added to the board. The other members were all reelected.

Rockwell Promotes Carson

Thomas O. Carson, manager of Rockwell Manufacturing Company's International division at New York for the past five years, has been promoted to assistant product manager, Nordstrom Valves. He will make his headquarters at the company's home office at Pittsburgh.

Insul-Mastic Adds Outlets

National Bond Insulators of Bethlehem, Pa., has accepted an Insul-Mastic licenseeship to sell and apply the line of reinforced asphaltic coatings marketed by Insul-Mastic Corporation of America.

Malcolm Builders, Inc., is now selling and applying the same line in the Indianapolis district.

General Wedemeyer Becomes Vice President of Rheem

Lieutenant General Albert C. Wedemeyer (U. S. Army, Retired), has been elected a vice president and director of Rheem Manufacturing Company. Gen. Wedemeyer will make his headquarters at the company's New York offices.

Wedemeyer

Gen. Wedemeyer has resigned a similar post he held since 1951 with Avco Manufacturing Company. He joined Avco shortly after his retirement in 1951 upon completion of 32 years of military service, during which time he won recognition as one of the nation's top military strategists.

ADM Buys Resin Division of U.S. Industrial Chemicals

The Resin division of U. S. Industrial Chemicals Division of National Distillers Products Corporation has been purchased by Archer-Daniels-Midland Company. Involved in the sale are U. S. I. resin plants at Newark, N. J., and Pensacola, Fla., along with inventories, formulations and trademarks owned by the Resin division.

Hills-McCanna Adds Two New Sales Representatives

Hills-McCanna Company has appointed two new sales representatives in New England. Power Specialties Company, Belmont, Mass., under the direction of John R. Greenhalgh, will represent Hills-McCanna in Maine, New Hampshire and Vermont. Kenneth H. Green, Boston, will represent the company in Massachusetts and Rhode Island and in Albany, Rensselaer and Schenectady counties in New York.

Marley Builds New Plant For Packaged Cooling Towers

The Marley Company, Kansas City, Mo., has built a new plant in Louisville to meet demand for the company's mechanical draft cooling towers for air conditioning and refrigeration service. The new plant, which has begun full operation, replaces Marley's former manufacturing facilities in Louisville. The new plant occupies ten acres and provides 77,000 square feet of production space.

Worthington Names Navrotsky

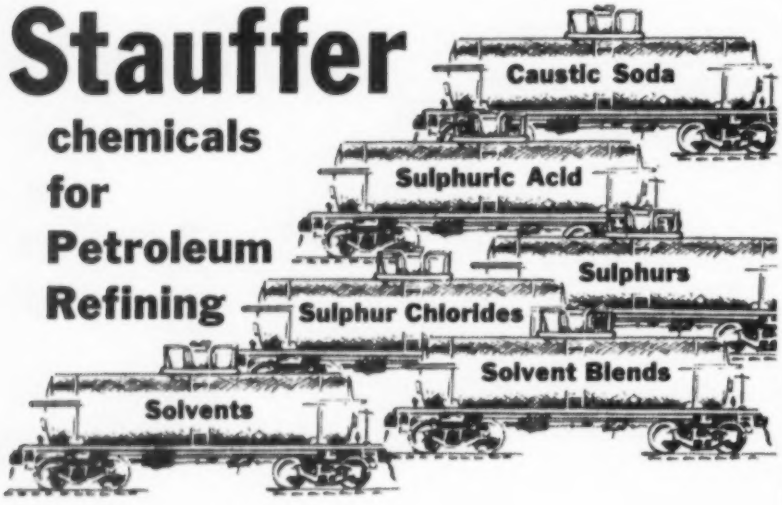
G. A. Navrotsky has been appointed manager for the Middle East for Worthington Corporation and will be headquartered in Istanbul, Turkey. He was formerly manager of the New York section Export department with headquarters in the corporation's New York office.

Bailey Moves Offices

The Los Angeles district office of Bailey Meter Company, Cleveland, Ohio, has been moved to larger quarters at

Stauffer

chemicals for Petroleum Refining



Basic Chemicals . . . Caustic Soda, Sulphuric Acid, Processed Sulphurs, Sulphur Chlorides are a few of the basic materials Stauffer supplies the petroleum industry.

Solvents . . . Carbon Disulphide, Carbon Tetrachloride, and Perchlorethylene are produced at 10 of the 38 Stauffer plants. These solvents are available in drum to tank car quantities—coast to coast.

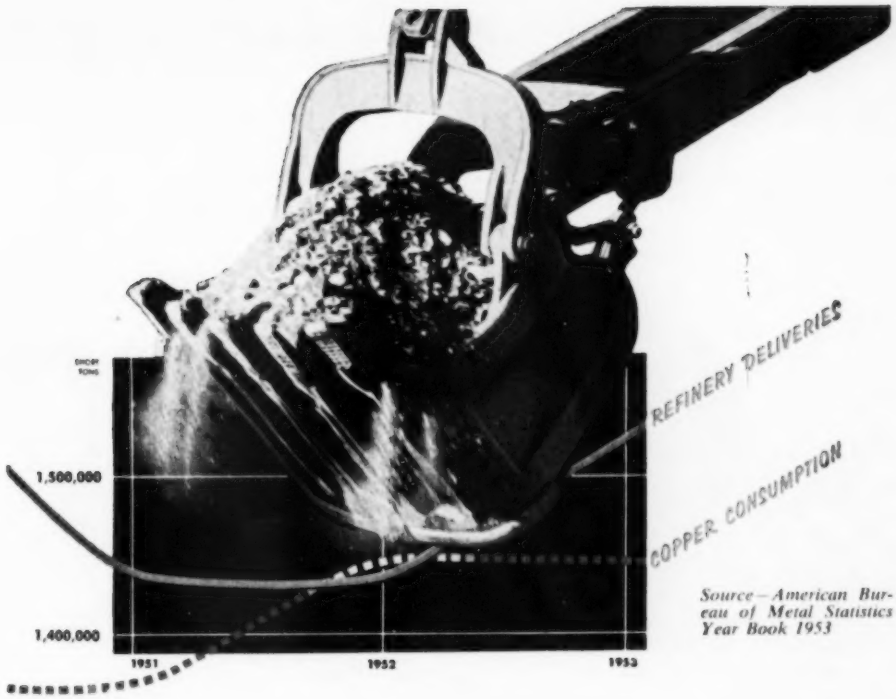
'Custom' Solvent Blends . . . Stauffer can also supply bulk quantities of blended solvents, needed by many refiners. Carbon Disulphide, Carbon Tetrachloride, or Perchlorethylene, in blends or in mixtures with other solvents, are available in drum or tank car quantities. Contact a Stauffer office for more detailed information.

Stauffer Chemical — Since 1891

STAUFFER CHEMICAL COMPANY

380 Madison Avenue, New York 17, N. Y.

221 N. La Salle St., Chicago 1, Ill. • 636 California St., San Francisco 8, Calif.
326 S. Main Street, Akron 8, Ohio • 824 Wilshire Boulevard, Los Angeles 14, Calif.
8901 Hempstead Rd., Houston 8, Tex. • N. Portland, Ore. • Weslaco, Tex. • Apopka, Fla.



Source—American Bureau of Metal Statistics Year Book 1953

Plenty of Copper... today and tomorrow

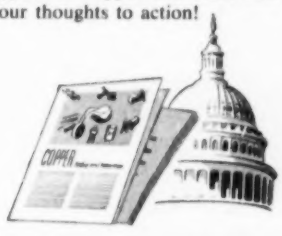
The assurance that copper is in abundant supply and *can be used without restrictions* is the "go ahead" for industry. You can now rate PERFORMANCE over AVAILABILITY when choosing materials. By using copper and its alloys, brass and bronze, your product is easier to fabricate, better and more durable.

We can get more copper than we now have. Although industry and government have been consuming more copper than in any previous peacetime period, production has kept pace with this increased demand. And producers are not working at full capacity!

More copper keeps on coming. Eleven major new projects in the U. S. will start producing in the next 3 years. These mines will add 250,000 tons to our annual production—more than *¼ of all the domestic copper mined during 1953*. In addition, recent improvements in mining techniques now make it possible to obtain copper from ores considered commercially unworkable in the past.

Copper is virtually indestructible. At least 3 out of every 4 pounds of copper used in today's products, when scrapped, can be re-used in the future. Every day we are adding to our "copper capital". The more copper we use . . . the more we have!

Copper has a new ability to serve you. Many of your problems are being solved in the laboratories of the copper and brass industry. Whether it's a new alloy, a different temper or a special property . . . copper can help you develop new ideas. Copper can bring old methods up to date. Call a supplier of copper and brass and convert your thoughts to action!



* ***"Copper . . . is fortunately available in ample supply to meet any foreseeable demand"***
Foreword, U. S. Dept. of Commerce
B.D.S.A. Copper Quarterly, August 1954

For information about U. S. copper supplies including free copies of this Government report and the new booklet, "Copper . . . Today and Tomorrow", send attached coupon to:

Copper & Brass Research Assn., Dpt. II
420 Lexington Ave., New York 17, N. Y.

NAME .....
COMPANY .....
ADDRESS .....
CITY ..... STATE .....

COPPER & BRASS Research Association

Copper or its alloys provide these advantages . . .

Best conductor of electricity commercially available.

Does not rust . . . high corrosion resistance.

Best heat transfer agent of all commercial metals.

Easy to machine, form, draw, stamp, polish, plate, etc.

Welds readily . . . excellent for soldering and brazing.

For more data on advertised products, use Readers' Service Cards, last page.

Pump manufacturer *standardizes* on LATTICE BRAID* Packing for *all* centrifugal pump models

*Registered Trademark. *Only* Garlock makes LATTICE BRAID rod and shaft packings.

Peerless Pump Division, Food Machinery and Chemical Corporation, Los Angeles, manufactures an entire line of centrifugal pumps. Before changing to LATTICE BRAID, Peerless regularly received frequent complaints on packing from their customers. Now that Peerless has *standardized* on LATTICE BRAID, complaints are rare. In addition, Peerless reports that LATTICE BRAID *resists* the excessive gland pressure often applied by uninformed repairmen. The result is that there is *less* packing and sleeve wear.

Put Garlock LATTICE BRAID Packing to work for your company. All the braided strands of this unique packing are lattice linked together into one structural unit. The strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

LATTICE BRAID is made from flax, cotton, asbestos, wire-inserted asbestos, Teflon, and asbestos with Teflon impregnation—for various types of services.

Get all the facts about LATTICE BRAID *Packings. Contact your Garlock representative or write for new folder AD-131.*

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N. Y.) • Philadelphia Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK LATTICE BRAID PACKING

Suppliers . . .

816 South Atlantic Boulevard, Monterey Park, Calif. The company's Cincinnati district office has been moved to larger quarters at 2330 Victory Parkway.

Foxboro Assigns Yahrmarkt to Tulsa as Industrial Engineer

R. S. Yahrmarkt, formerly with Ethyl Corporation of Baton Rouge, La., has joined The Foxboro Company of Foxboro, Mass. He has been assigned to Foxboro's Tulsa office as an industrial engineer and will serve instrument users in the Oklahoma area, working under the direction of J. E. Hewson, branch manager.

Yahrmarkt

Yahrmarkt's experience in the field of process control includes three years of service with Ethyl as an instrument engineer, and two years with the Armour Research Foundation in Chicago.

BS&B Personnel Changes Move Kirkpatrick and Morris

In changes at Black, Sivalls & Bryson, Inc., Hugh Kirkpatrick has been appointed manager of the Kilgore, Texas, branch of Oilfield Sales, and R. P. "Dick" Morris has been transferred from Wichita Falls to Gainesville, Texas, as sales representative.

International Nickel Expands Huntington Works Facilities

One of the largest truck terminals in metal warehousing is one of the features of the new distribution center of The International Nickel Company at Huntington, W. Va. Planned and engineered to speed operations, the recently completed $1.7 million unit has the latest equipment for straightening, cutting and inspecting its metal products. It increases the company's warehouse facilities at its Huntington works by 50 percent.

Hooker Adds Two to Staff

Dr. Alex Katona and Benjamin B. Halleck, chemical engineers, have been added to the staff of Hooker Electrochemical Company, Niagara Falls, N. Y. Katona, who recently completed requirements of a doctor's degree at Case Institute of Technology, has joined the Research and Development department in the Pilot Plant group. Halleck, recently of the U. S. Navy, has been assigned to the Process Study group of Hooker's Operation department.

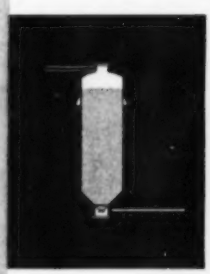
Westinghouse Employes Set New Safety Record in 1953

For the fifth consecutive year, employes of Westinghouse Electric Corporation have set an all-time company record for safety. During 1953 the employes had one-third as many injuries for each million man-hours worked as the average for all industry. During the

ATTAPULGUS Fullers Earth

POROCEL Activated Bauxites

. . . reliable sorptive minerals for petroleum and chemical processing



WANT TO PURIFY BY ADSORPTION?

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils; chemicals and petrochemicals.

HAVE CATALYST OR CATALYST CARRIER NEEDS?

Our sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.

WHAT DO YOU WANT TO DRY?

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

SPECIAL GRADES

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs are ready to assist in research, development, design and operating problems. Your inquiries are invited.

ATTAPULGUS DIVISION
Minerals & Chemicals Corporation of America

POROCEL
Corporation

DEPT. W, 210 WEST WASHINGTON SQUARE, PHILADELPHIA 5, PA.

For more data on advertised products, use Readers' Service Cards, last page.

How would YOU solve these two problems?

1. MEN AND WOMEN BOTH like nylon fabrics. Important key to producing successful nylon fabrics is the heat-setting process. Temperature-control must be accurate, and reliable yet readily adjustable. "National" Nylon Heat Setting Machines used by the leading textile mills employ THERMOSWITCH® units in the heated rollers . . . get highest efficiency . . . greatest safety . . . most economical fuel consumption.

2. BABY INCUBATOR MUST BE SAFE. Engineers who design Armstrong Baby Incubators say "Safety is a *must* where babies are concerned. That is why all our baby incubators are tested and approved by Underwriters Laboratories. That is why we use only Fenwal THERMOSWITCH units to control all-important temperature and humidity. Inspection reports on more than 22,000 THERMOSWITCH units show a remarkable picture of consistent reliability."

3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature problems and helping to improve the final product throughout all industry.

4. SEND FOR THIS BROCHURE for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Incorporated, 109 Pleasant St., Ashland, Massachusetts.

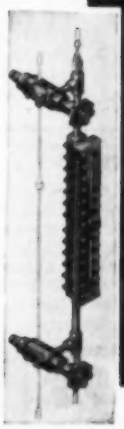
Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*

get accurate level reading of hot or cold liquids



Reflex type, internal tube model

with Jerguson Heated and Cooled Gages

Here's your answer if you have the problem of getting accurate level readings of liquids that boil or surge or liquids that are heavy and don't flow at normal temperature. Jerguson Heated and Cooled Gages are specially designed and built to carry a cooling circulating medium to control boiling tendencies . . . or a heating circulating medium to speed the flow . . . so you get *accurate* readings. These gages are also ideal in cold weather applications for they can be heated to prevent gage freezing and breakage.

Jerguson's high standards of design are followed throughout; and materials are selected to exceed or conform to A.I.S.I., A.S.T.M. and/or A.P.I.-A.S.M.E. requirements. Available in external or internal tube models, reflex or transparent types, in a large number of sizes and pressure groups.

You'll get rid of the troublesome problems involved in steam tracing and won't have to insulate gages or valves, you'll eliminate the problem of getting accurate level readings of hot or cold liquids, and you'll cut maintenance hours and costs with Jerguson Heated and Cooled Gages. Send for detailed Data Unit and full information.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

Suppliers . . .

last five years, company employes have lowered frequency of accidents 42 percent and severity of injuries 20 percent.

Gray Tool Adds Christopher As Head of New Department

Dan Christopher has been appointed marketing manager in Gray Tool Company's newly created Market Research department.

Christopher

A mechanical engineering graduate from the University of Illinois, Christopher has 20 years experience in oil refinery and oil field work. He was formerly in the Houston engineering office of Foster Wheeler Corporation, serving as assistant engineering manager. In his new position he will headquarter in Houston. Prior to moving to Houston in 1947, he was merchandising manager of Ideal Industries, Inc., Sycamore, Ill.

American Cyanamid Transfers Henderson to New Sales Post

Bancroft W. Henderson has been appointed director of sales of the Organic Chemicals division of American Cyanamid division. He was formerly manager of Intermediate & Rubber Chemicals department of Calco Chemical division. His appointment results from the recent reorganization of Cyanamid's divisional structure.

Kopecki Becomes Manager of Public Relations at Selas

Selas Corporation of America, Philadelphia, has appointed Ernest S. Kopecki manager of public relations and promotion. Kopecki has been associated with Corborundum Company for the past several years as assistant to the manager of public relations.

Reed to Step Down As Chairman of Lummus Board

Carl S. Reed has announced his retirement as chairman of the board of directors of The Lummus Company, a post he has held since 1949. Reed succeeded Walter E. Lummus as president in 1931 and was succeeded in that post by J. F. Thornton in 1951.

Farris Appoints Gierse

Robert N. Gierse has been appointed sales manager of Farris Flexible Valve Corporation. For more than five years Gierse was industrial sales manager in the Instrument division of Thomas A. Edison, Inc.

Dow Opens Cincinnati Office

The Dow Chemical Company has opened a new field office at Cincinnati, Ohio, to serve southern Ohio, southeastern Indiana and sections of Kentucky and West Virginia. It will be

JET-LUBE
KOPR-KOTE
THREAD LUBRICANT and SEAL

HEAT RESISTANT

Avoid leaks in casing and tubing with JET-LUBE's high temperature KOPR-KOTE. Contains fine ground metallic copper. Hundreds of wells cased and tubed without a "leaker." Batch controlled. Fully guaranteed.

Order through your supply store or send for complete details

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Make a Date for More POWER with
SAND-BANUM
Pure Colloidal Concentrate

SAVE
POWER PLANT
DOLLARS AND
TIME

Ounces Only Once a Week
Remove and Prevent
Boiler Scale and Corrosion

Power Goes Up
Maintenance Goes
Down

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Established 1926
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PETROLEUM TESTING EQUIPMENT
used by...
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• Petrochemical Plants
W. H. CURTIN & CO.
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LABORATORY APPARATUS & CHEMICALS
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TULSA · BIRMINGHAM · VTA.

VICTOR ALLOY STUDS
UNIFORM, CLEAN, ACCURATELY THREADED, STRICT ADHERENCE TO SPECIFICATIONS
VICTOR alloy Studs and Bolts have met the exacting standards of the oil industry for more than 30 years. Victor is accustomed to meeting your requirements of quality, price and delivery. Try VICTOR next time you need any fastening.
Write for the new, easy to use VICTOR catalog.
VICTOR PRODUCTS CORP.
2635 W. BELMONT AVE. · CHICAGO 18, ILL.

Suppliers . . .

under the direction of Fielding H. Yost, Jr., manager of the Cleveland office.

ALCO Appoints Batts In Move To Strengthen Marketing Staff

Arthur A. Batts, Jr., has been appointed director of market research at American Locomotive Company.

Prior to his appointment Batts was director of commercial research at Carborundum Company of Niagara Falls.

In his new position, Batts will conduct marketing surveys, suggest product opportunities, provide marketing and economic forecasts and make available various data on business activity.

Batts' appointment stems from recent moves by ALCO to build up its marketing organization to handle the company's recent expansion into new fields. Last year, for the first time in its history, ALCO's production of "new" regular products reached $85 million, or just about the volume of its annual locomotive sales.

Adding to Catalyst Plant

The Girdler Company, Louisville, Ky., has begun the erection of a major addition to its catalyst plant. The addition is scheduled for completion and operation late in 1954, or early in 1955. At that time, Girdler's catalyst manufacturing operations will be consolidated at the new facility.

Johns-Manville Opens New Lab

A new laboratory devoted to research and development of asbestos brake linings and other friction materials has been opened at Manville, N. J., by Johns-Manville Corporation.

The company has also completed an addition to its plant at Waukegan, Ill., which will nearly double the passenger car and industrial friction material production capacity there.

Aerofin Moves to New Plant

Aerofin Corporation has moved to a new plant at 101 Greenway Avenue, Syracuse, N. Y. The new plant contains 80,000 square feet of production space on one floor, and occupies a 6-acre plot adjacent to the New York Central main line. The entire plant will be devoted exclusively to the manufacture of extended heat-exchange surface.

Viking Appoints Distributors

Three new Oklahoma distributors have been announced by Viking Pump Company for its line of rotary pumps. They are: Miller Equipment Company, Tulsa—Eastern Oklahoma; Duncan Equipment Company, Duncan—Central Southern Oklahoma; and Woodford Supply Company, Oklahoma City—Oklahoma City and vicinity.

Davison Appoints McGuirk Executive Vice President

William E. McGuirk, Jr., has been appointed executive vice president of Davison Chemical Company Division of W. R. Grace & Co. He has been a vice president of W. R. Grace since January of this year. He will make his headquarters at Baltimore, Md.

Green Buys British Company

Liptak Furance Arches, Ltd., 68 Victoria Street, London, S. W. I, England, has been purchased by A. P. Green Fire Brick Company, Mexico, Mo. For a number of years the British company has manufactured refractory specialty products under license from the Green Company.

Clark Adds 13 New Dealers

Thirteen new dealers have been appointed to sell and service the Michigan line of excavator-cranes and tractor shovels of the Construction Machinery division of Clark Equipment Company. Eight of the dealers will handle both excavator-cranes and tractor shovels,

JET-LUBE
VL-5
VALVE LUBRICANT

MICRO-GROUND
JET-LUBE VL-5 is a low friction, valve lubricant with micro-ground moly-disulphide. Ends "sticking" valve problems. High temperature. No melting point. Insoluble in hydro-carbon solvents, water, brine, sulphur, acids and alkalies. Batch controlled. Fully guaranteed.
Order through your supply store or send for complete details
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Since 1915
CONCRETE
SAND AND CEMENT
"Placed by Air"
We have the equipment, personnel and experience to complete any and all GUNITE work regardless of size or location.
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St. Louis—Minneapolis—Denver—New Orleans

HELP WANTED

CHEMICAL ENGINEER

Houston oil refinery has opening for graduate chemical engineer with 5 or more years experience in the petroleum industry. Send complete resume to P. O. Box 5008, Harrisburg Station, Houston, Texas.

CHEMICAL ENGINEERS

Graduate chemical engineers with minimum 3 years process design experience in oil refinery or surface oil producing facilities. Equivalent graduate training acceptable in lieu of experience. For New York office. Must be willing, however, to relocate in foreign operations at some future date.

Salary commensurate with experience and training. Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor,
Box 31
ARABIAN AMERICAN OIL COMPANY
505 Park Avenue
New York 22, N. Y.

■ PROCESS ENGINEERS: Permanent positions available requiring a Ch E degree and 3 or more years experience in process design and development of oil refinery or chemical plant units. These are excellent opportunities to join an organization known throughout the world for accomplishments in these fields, located on the East Coast. Traveling and moving expenses paid. Please submit complete resume and state initial salary desired. Box. No. 424, Room 1201, 230 West 41 St., New York 36, N. Y.

■ PROJECT ENGINEERS: Requires a mechanical or chemical engineering degree and at least 5 years diversified experience in petroleum and chemical plant design and development work. Will be responsible for coordination of process and design to insure customer specifications are met. There is considerable customer and vendor contact. These are permanent positions with an internationally-known organization located on the East Coast. Salaries are high, and the many employee benefits include executive insurance and a liberal pension plan. Traveling and moving expenses will be paid. Please write complete details and include initial salary requirements. Box #421, Room 1201, 230 West 41 St., New York 36, N. Y.

while five will handle only Michigan's tractor shovels.

Honeywell Establishes Big Dealer Training Aid Program

A nationwide network of training aid libraries has been set up by Minneapolis-Honeywell Regulator Company to help dealers, wholesalers and builders to better understand the operation of automatic temperature regulating devices.

The 24 U. S. and two Canadian training aid centers are to provide company sales engineers with visual aid materials which could be used in meetings with customers for announcements of new Honeywell products.

PETROLEUM REFINER Classified Ads

FOR SALE

SPECIAL LIQUIDATION!

TOWERS & COLUMNS

8′ x 61-6 stainless steel, 15 trays	7′-6″ x 55′ steel tower, 30 trays
7′ x 25-6 stainless steel, 10 trays	7′ x 42′ steel tower, 20 trays
6′ x 64′ stainless steel, 35 trays	7′ x 5′ x 70′ steel tower, 38 trays
6′ x 45′ stainless steel, 850 psi	6′ x 63′ steel tower, 36 trays
4′ x 110′ stainless steel, 79 trays	5′ x 61′ steel tower, 16 trays
4′ x 72′ stainless steel, 45 trays	4′ x 72′ steel tower, 40 trays
2′ x 73′ stainless steel, 50 trays	3′-6″ x 63′ steel tower, 35 trays
2′ x 39′ stainless steel, 30 trays	2′-6″ x 60′ steel tower, 35 trays

2′ x 75′ steel tower, 45 trays

HEAT EXCHANGERS

2—1440 sq. ft. stainless steel
75—atmospheric heat exchangers, steel and stainless in 715, 477, 358, 108 sq. ft. sizes.
2—1125 sq. ft. steel, 850#
9—Kettle type reboilers, steel and stainless 1270, 1125, 750, 660, 400, 340, 100, 80, 50, 31 sq. ft. sizes.

OTHER ITEMS

2—1380 gal. stainless steel tanks, 90 psi; 3—6′ x 32′ heresite lined tanks 74 psi.
60—turbine-driven centrifugal pumps, steel and stainless construction from 1″ x 1″ to 8″.
2—Pacific six-stage centrifugal pumps, 730 GPM
4—B-J stainless steel pumps, 8″ x 6″, 1500 GPM
2—Oliver 8′ x 10′ rot. vac. filters, complete; 1—Bird 36″ x 50″ solid bowl centrifuge.
2—Drum flakers 8′ x 12′, 4′ x 6′; 1—Devine 2000 gal. steel jacketed reactor.
Sweetland filters No. 12, 10, 7, 3 sizes; Niagra, type H horizontal filter, 450 sq. ft. unused.
2—Unused I-R air compressors with 3580 cfm GE 600 hp sync. motors, in original crates.
Clark, type VT, TR spare cylinders; Nash H-6 vac. pumps.
3—I-R steam-driven propane compressors, 5400 #/hr.
2—Clark MA-4 Right angle gas engine compressors, 150 BHP
High pressure gas-fired tube still furnace, 15 Mil BTU hr.
2—Union Iron Works 30,000 #/hr. water tube boilers, 240 psi, complete.
Complete Oxygen plant, built by Stacey-Dresser, 170 Tons day. Complete details on request.

BRILL EQUIPMENT COMPANY
4101 SAN JACINTO STREET, HOUSTON 4, TEXAS
Telephone: JUstin 6032
Write, wire or phone us for complete information — Send us your surplus equipment lists today

HELP WANTED

CHIEF ENGINEER and MAINTENANCE SUPERINTENDENT

Resourceful man wanted with at least seven (7) years experience in petroleum refinery maintenance and engineering department, two (2) years of which should be in areas with fairly severe winter conditions. Supervisory experience necessary as well as knowledge of catalytic cracking and coking plant operations. M. E. Degree or equivalent required.

Salary commensurate with ability. Reply by letter giving complete resume of personal and work history.

GREAT NORTHERN OIL COMPANY
P. O. Box 3596 St. Paul, Minn.

POSITIONS WANTED

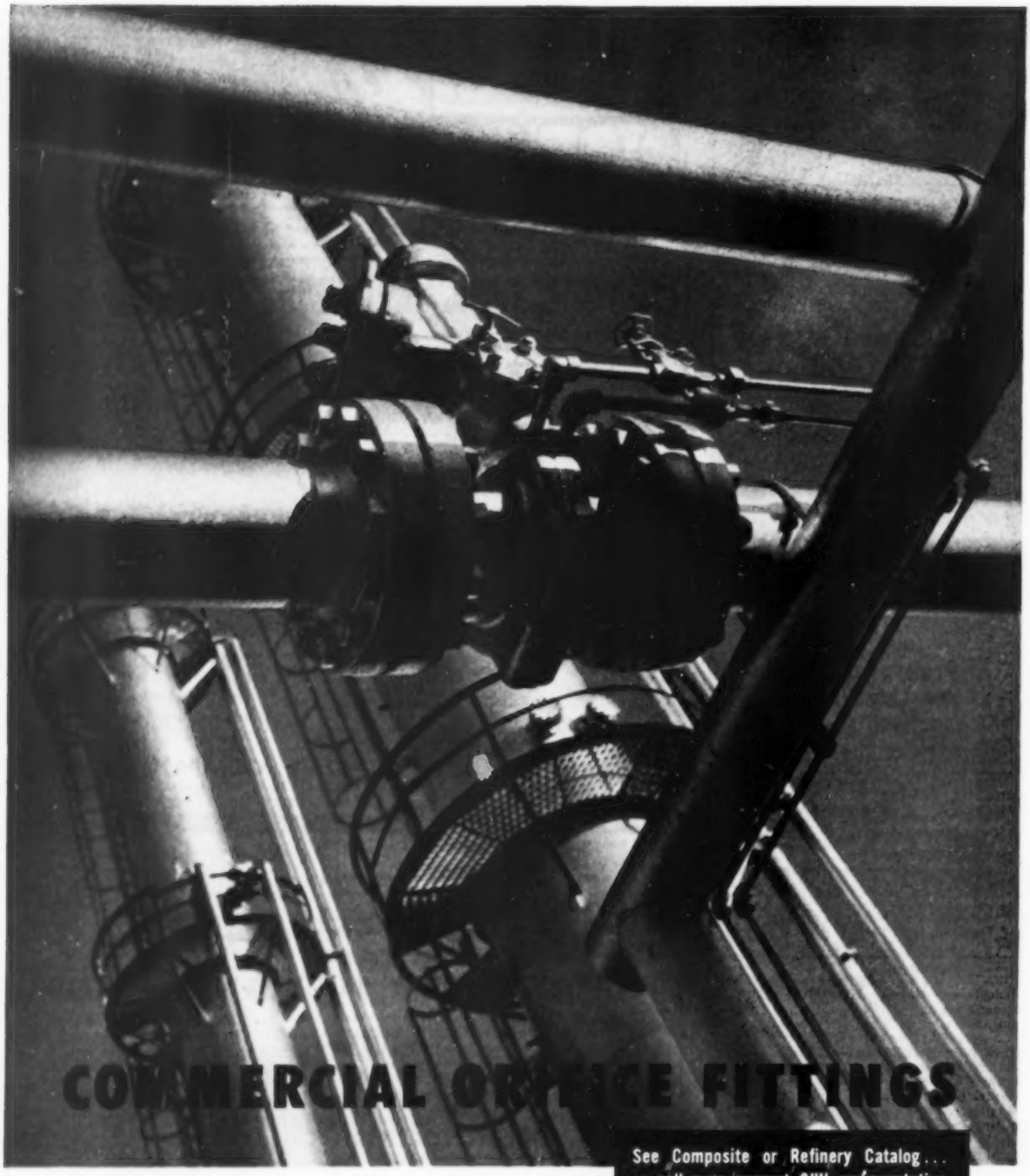
POSITION WANTED

By master mechanic on foreign construction project, twenty-five years experience on maintenance and operation of all types of construction machinery, have worked on projects in Europe & South America. Am also qualified and capable of operating various types of heavy equipment. Available immediately, references on request. Box 186-R, c/o Petroleum Refiner, Houston, Texas.

FOR SALE

GLASSES & GASKETS

ALL SIZES TO FIT YOUR GAGES & VALVES
ERNST WATER COLUMN & GAGE CO.
Send for Catalog, LIVINGSTON, N. J.



See Composite or Refinery Catalog . . .
or call your nearest CIW representative

for controlled metering on oil and gas production, transmission and gathering lines

This striking photo shows installation of a Commercial Type CN Orifice Fitting on absorber gas inlet line at an Oklahoma refinery. There is a suitable Commercial Orifice Fitting for every application and service.

COMMERCIAL IRON WORKS

2424 Porter Street, Los Angeles 21, California

ARKANSAS, KANSAS, OKLAHOMA: The Condit Co.
1011 S. Main St., Tulsa 3, Okla.

CALIFORNIA: Fred P. Koenig Co.
1040 S. Olive St., Los Angeles 15

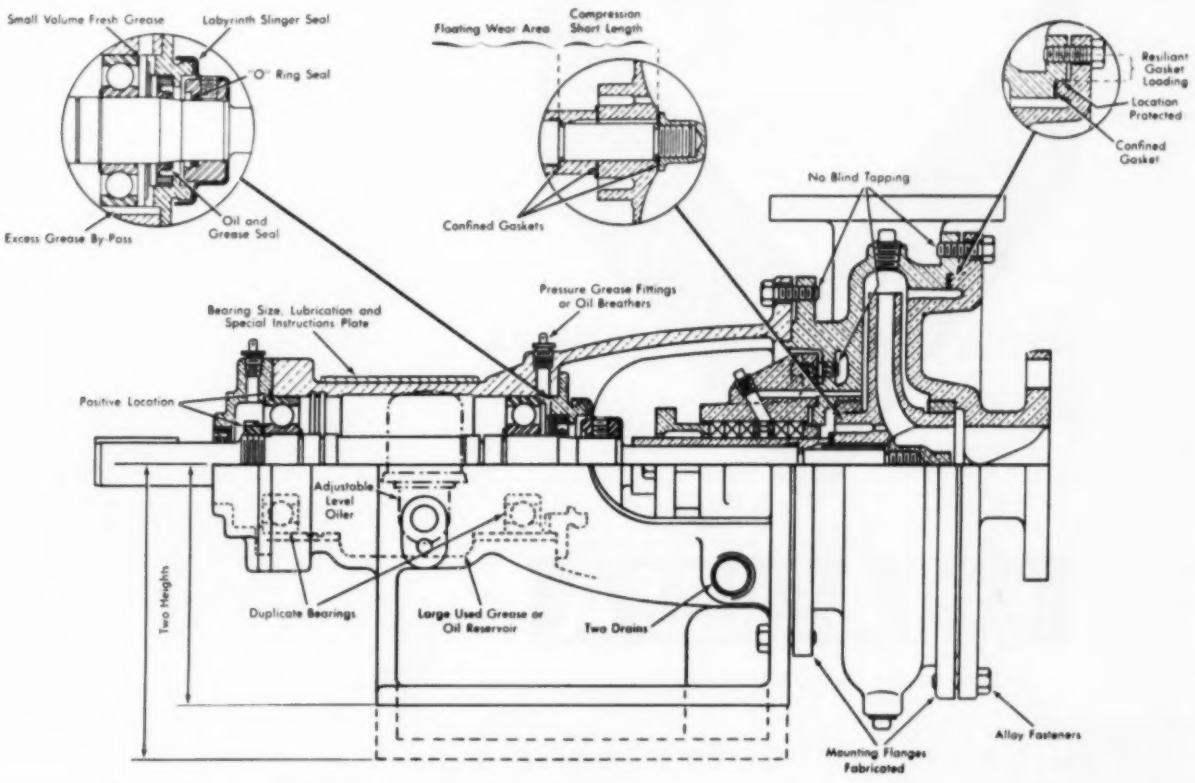
LOUISIANA: Coastal Engineering Corp.
P. O. Box 11036, New Orleans 13

TEXAS: Maintenance Engineering Corp.
P. O. Box 2637, Houston 1

MEXICO: Schultz y Cia., S.A.
Melchor Ocampo No. 340, Mexico 5, D.F.

CANADA: Peacock Bros., Ltd., 1029 11th Ave., W., Calgary, Alta., 1669 Eglinton Ave. W., Toronto 10, Ont.; P. O. Box 6070, Montreal, Que.

What's New In Equipment . . .



Corrosion troubles? Here's a solution in a new series of . . .

Versatile Centrifugal Pumps

A new series of production-built centrifugal pumps adaptable to almost any special customer requirements has recently been announced by Ampco Metal, Inc. These new 1750 rpm single section pumps are available in sizes ranging from fractional flow to 600 gpm. Units are also available from stock constructed entirely from Ampco alloys or nickel chrome alloys to combat the effects of corrosion and erosion. They are particularly designed to transfer liquids that are normally difficult to handle because of their erosive and corrosive nature.

The unique feature of this new line is the ease and rapidity with which pump components may be interchanged to fit the requirements of various specialized jobs. This permits the engineer in the field to satisfy all the requirements of his operation, and to get a pump that is tailor-made for his job without going to the expense of a special unit.

For example, starting with the basic pump, the type of lubrications and bearings best fitted for the job can be specified. The type seals and impeller needed can be chosen. The new pump also offers a choice of several shaft constructions and two pedestal heights. In addition, this new pump series is engineered and designed to permit field changes at low cost. This means that the pump can be ordered to meet the needs of a particular situation, and then can be easily and quickly changed to fit practically any other condition.

Three types of bearing lubrication, permanent seal double width, replenishable grease, or oil lubricated are available with this new line of pumps. Either medium or light duty bearings to match the choice of shafts, depending on the pump's contemplated use, can be selected.

Either packed stuffing boxes or mechanical shaft seals can be specified. Packed stuffing boxes have either internal, external or flushing seals, and may be changed from one to the other by rotating a single part. Any known stuffing box arrangement can be made without changing parts or dismantling. Water-cooled boxes are also available. Both inside and outside mechanical shaft seals are applied interchangeably to these pumps without excessive shaft overhang. Space is provided for seals to be lubricated and/or cooled.

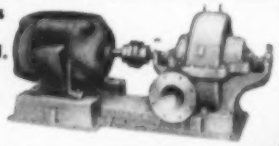
Several other proved mechanical features, included as standard, characterize the Ampco pump line. One important feature is multi-seal protection of bear-

Faithful Performance on Important Jobs

— such as water supply, brine circulation, booster service, white water and overflow, hot well, makeup water, etc., etc.

Capacities to 1,200 G.P.M.

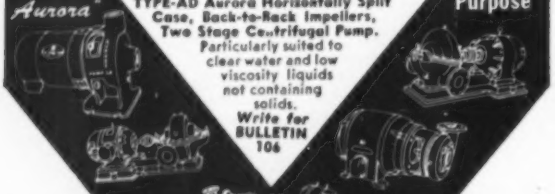
Heads to 460 Ft.



PUMPS "by Aurora"

For Every Purpose

TYPE-AD Aurora Horizontally Split Case, Back-to-Back Impellers, Two Stage Centrifugal Pump. Particularly suited to clear water and low viscosity liquids not containing solids. Write for BULLETIN 106



APCO TURBINE-TYPE PUMPS are unbeatable on low capacity, high head duties.

Capacities to 150 G.P.M. Heads to 500 Ft.

AURORA CENTRIFUGAL PUMPS are available in many types and sizes —all noted for their streamline coordination between impellers and shells.

Write for CONDENSED CATALOG "M"

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS

AURORA PUMP COMPANY

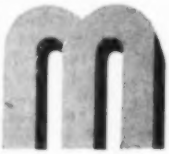
DIVISION OF THE NEW YORK AIR BRAKE COMPANY

84 LOUCKS STREET, AURORA, ILLINOIS

You get the Best Protection when you use

Mundet Cork Insulation

There is nothing like Cork—nature's own insulation! Because of its natural, inherent insulating qualities, Cork is the accepted *standard of comparison* when insulating performance is considered. Mundet selects its raw cork from the world's best rated cork growing centers . . . fabricates it by the most modern methods for low temperature applications. Available in pipe covering or corkboard.



MUNDET CORK CORPORATION
Insulation Division
7301 Tonnelle Ave., North Bergen, N. J.

Without obligation, send me your insulation manual, describing Mundet Cork Insulation Products.

NAME .....

FIRM .....

ADDRESS .....

Mundet Insulation Products include: "Custom-Molded" 85% Magnesia Pipe Covering; Magnesia Blocks and Segmental Covering; High Temperature Pipe Covering and Blocks; "Jointite" Cork Pipe Covering and Corkboard

New Equipment . . .

ings. This replenishable grease lubricated bearing arrangement has been improved so that used and surplus grease is carried away from the bearing when fresh lubricant is being supplied.

This item supplements Ampco Metal, Inc. data on pages 133-136 of The Refinery Catalog, 21st Edition.

Circle E1 on Postcard

Rowan Outlet

Now available from Crouse-Hinds Company, the Rowan pipe 620-83GX oil immersed power outlet has a manually operated, mechanically interlocked switch handle and plug that prevents insertion or removal of the plug while the switch is in the on position. This feature prevents the occurrence of an accidental shut-off of circuit power.

Designed for readily connecting portable equipment such as mixers, agitators, and welding machinery, the Rowan switch has such other features as:

- Sealed-off terminal compartment and safety jack.
- Provision for padlocking the switch in off position.
- Top and bottom conduit entrance.
- All parts oil immersed to prevent corrosive substances from freezing their operation.
- Manually operated disconnect switch with quick make and break mechanism.

Complete details are available on this unique outlet and safety switch now. Just . . .

Circle E2 on Postcard

Fluid Cracking Catalyst

American Cyanamid Company has recently announced the development of a new high alumina fluid cracking catalyst for use in petroleum refining. This new product has already been subjected to test performance in a commercial fluid unit at a major oil refinery for more than one year.

The new catalyst has an alumina con-

FROM THE WORLD'S
LARGEST PRODUCER
OF ALLOY STEELS

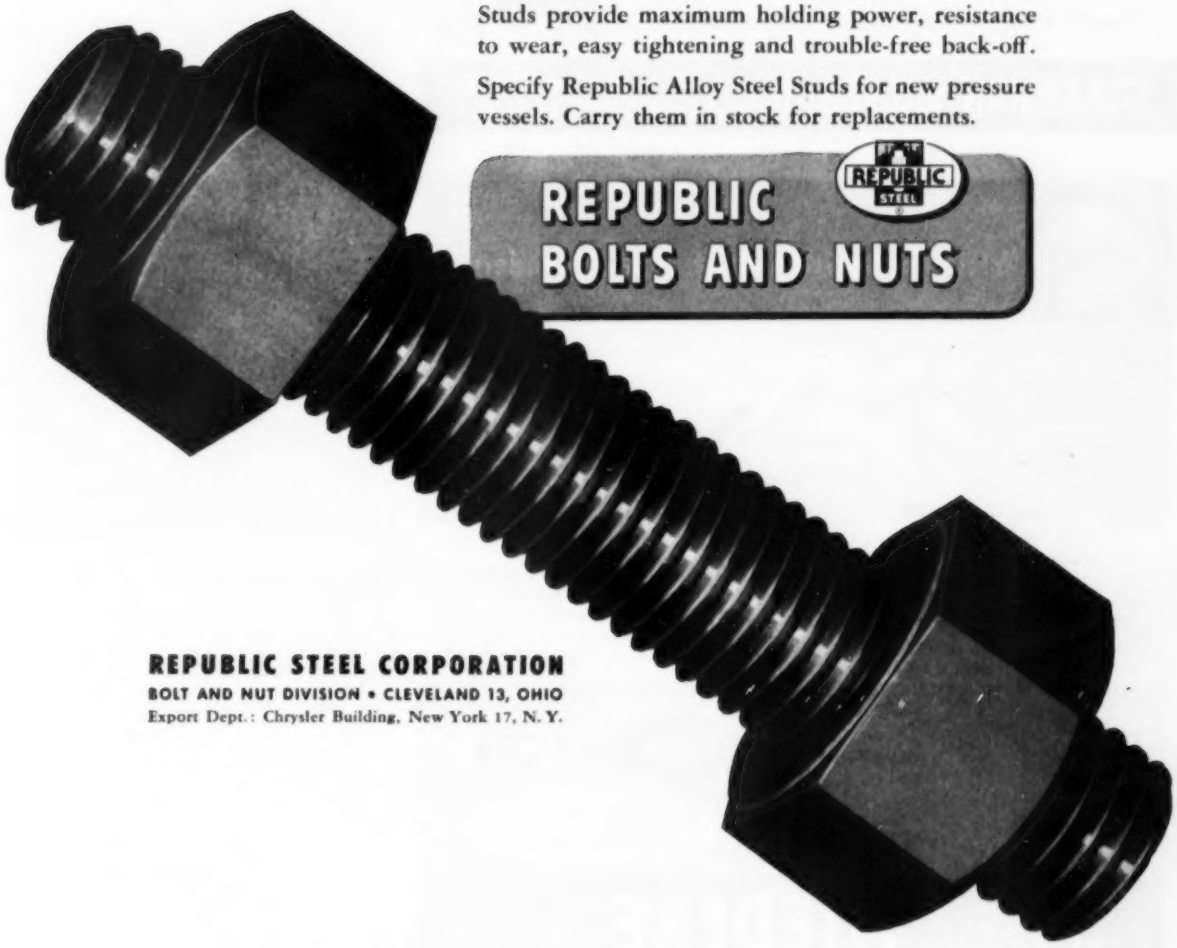
STRENGTH YOU CAN RELY ON
under heat and pressure . . .
REPUBLIC ALLOY STEEL STUDS

Republic-made alloy steels assure maximum tensile strength to stand up under wide extremes of heat and pressure.

Clean, accurate threads on Republic Alloy Steel Studs provide maximum holding power, resistance to wear, easy tightening and trouble-free back-off.

Specify Republic Alloy Steel Studs for new pressure vessels. Carry them in stock for replacements.

REPUBLIC BOLTS AND NUTS



REPUBLIC STEEL CORPORATION
BOLT AND NUT DIVISION • CLEVELAND 13, OHIO
Export Dept.: Chrysler Building, New York 17, N. Y.

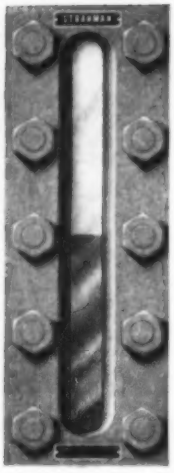
Other Republic Products include: Bolts, Studs, Nuts and Rivets—Pipe—Sheets—Plates—Electrunite Heat Exchanger Tubes

For more data on advertised products, use Readers' Service Cards, last page.

Strahman

LIQUID LEVEL GAUGES

REFLEX
•
THRU VISION
•
TUBULAR



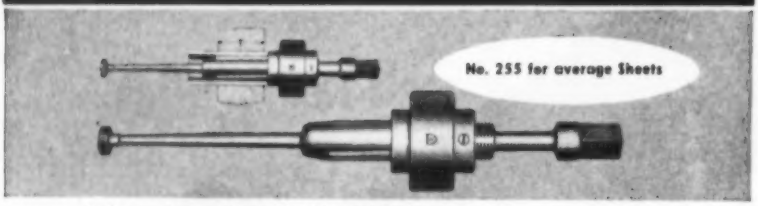
Standard Equipment
in
Leading Refineries
and
Industrial Plants
All Over the World!

Send for Complete Catalog and Specifications

STRAHMAN VALVES, INC., 16 HUDSON STREET NEW YORK 13, U.S.A.

IDEAL

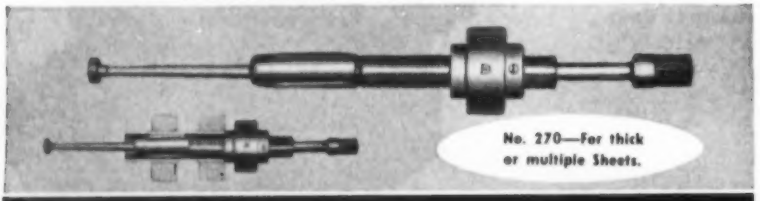
WIEDEKE Precision-Built Tube Expanders



Ball Bearing Adjustable Thrust Collar Tube Expanders are made for Tubes ¼" diameter and larger.
Recommended for use with any Controlled Rolling Motor for uniform expansion of Tubes.

See your Dealer or write us for Bulletin.

For Rolling—Heat Exchanger, Condenser and other Heat-Transfer Tubes.



THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

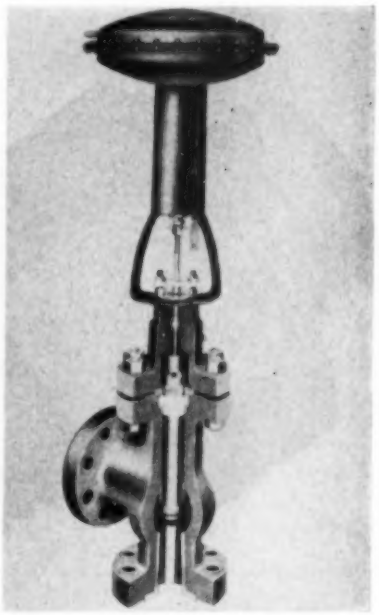
New Equipment . . .

tent of 25 percent by weight, as contrasted with the 13 percent normally used in synthetic catalyst. Favorable results obtained from laboratory tests and a year of commercial application include a greater stability of catalytic activity, a 15 to 25 percent higher equilibrium activity, and, in many cases, improved selectivity of end-product distribution. In addition, stack losses resulting from use of the new catalyst are reported as considerably lower than those ordinarily obtained under comparable operating conditions with the use of the 13 percent alumina product.

Samples are available for laboratory evaluation, and expansion of present production facilities will make additional commercial quantities available soon.

For complete details on this new product, simply . . .

Circle E3 on Postcard



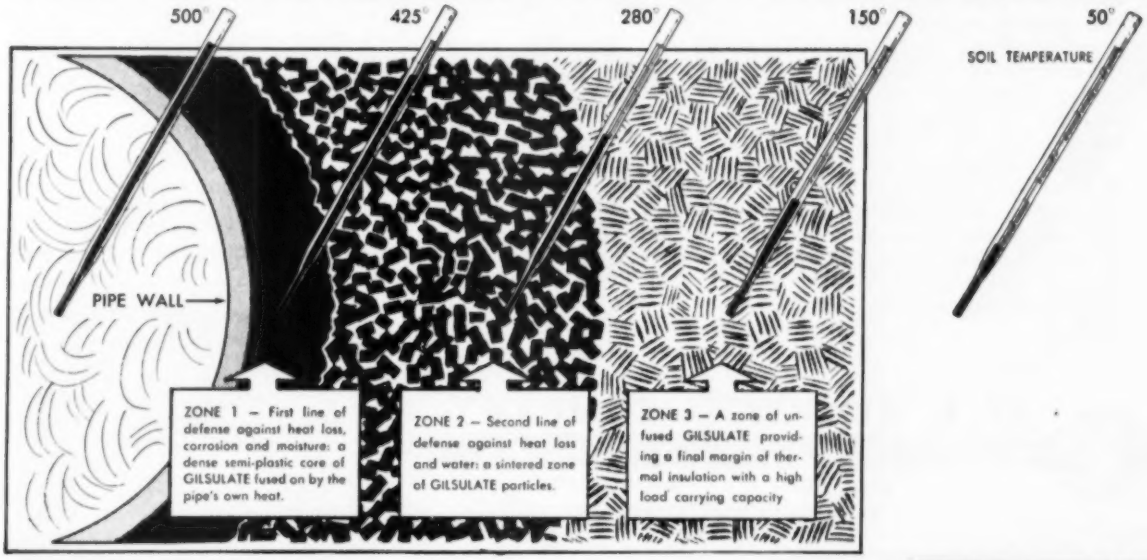
Angle Valves

Balanced control at high pressure differentials with tight shutoff is a major design feature of new seal balanced angle valves recently announced by Hammel-Dahl Company. These valves embody all the advantages of Venturiflo design, such as corrosion resistant retain seat ring, reduced turbulence, Venturi throat design, large flow capacity, and, in addition, elimination of the plug unbalance usually associated with single seated valves.

The force caused by line pressure working against the cross sectional area of the plug is cancelled out by means of a drilled hole along the axis of the plug which intersects radially drilled holes near the top. The line pressure is thus transmitted through this passage and exerts a force downward on the plug equal to the upward force. As a result

Lowest Cost

PER INSTALLED LINEAR FOOT OF ANY HOT UNDERGROUND PIPE INSULATION


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 – First line of defense against heat loss, corrosion and moisture: a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.
ZONE 2 – Second line of defense against heat loss and water: a sintered zone of GILSULATE particles.
ZONE 3 – A zone of unfused GILSULATE providing a final margin of thermal insulation with a high load carrying capacity

GILSULATE®... the triple-zone insulation that fuses itself into lifetime protection for hot underground pipes. Water-proof, corrosion-proof, root-proof, acid/alkali-proof.

Compare your present insulation methods with Gilsulation:

1. Pour Gilsulate granules out of the bag onto the pipe; tamp it down.
2. Backfill: *the job is insulated!*

Gilsulate—nature's own insulation—is a unique, solidified hydrocarbon that virtually installs itself. Normal pipe-heat (up to 520°F) does the rest—fuses the Gilsulate to the pipe in hours, forming a massive circular solidified sheath.

Gilsulate costs less installed per linear foot *than any other underground pipe insulation*... it's easiest to use... and has been tested in scores of the country's largest and most important installations.

Some additional Gilsulate advantages:

- *3 grades available*—220° to 520° F
- *needs no sleeves* or mechanical sheaths
- *requires no mixing* or special handling
- *can't be punctured* – leave rocks in backfill
- *pipe expands and contracts* within Gilsulate structure
- *proved in actual use* in hundreds of new construction and replacement installations

Send coupon for descriptive literature.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

No skills necessary—simply pour Gilsulate out of 100 pound bags, tamp and backfill. Can be used under any and all conditions—no matter how many pipes, whatever the space.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES.

American Gilsonite Company
134 West Broadway, Salt Lake City 1, Utah
or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on Gilsulate.

NAME _____

TITLE _____

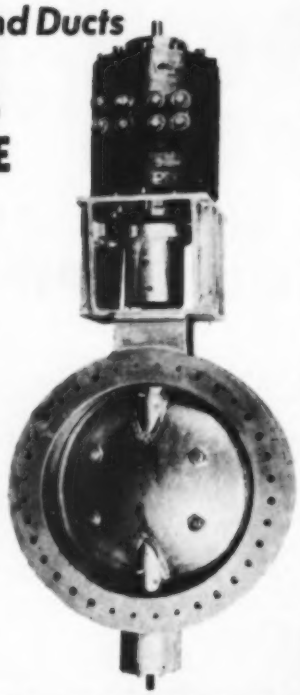
COMPANY _____

ADDRESS _____

PR

A Boon to Your Pipe Lines and Ducts

- **POSITIVE CONTROL**
- **INSTANT RESPONSE**
- **TIGHT SHUT-OFF**



This W. S. Rockwell 30" cast steel Butterfly Valve, with stainless steel rim on valve disc for corrosion resistance, handles air and hydrocarbon exhaust gases at 50 p.s.i. and 350° F. maximum temperature. It is operated by a heavy duty hydraulic rotary cylinder.

W. S. Rockwell Valves are made in sizes to 132", of any metal or rubber-lined with any automatic or manual operator. They are designed to meet required operating conditions at temperatures to 2000° F. and pressures to 300 p.s.i. and higher.

W. S. ROCKWELL COMPANY

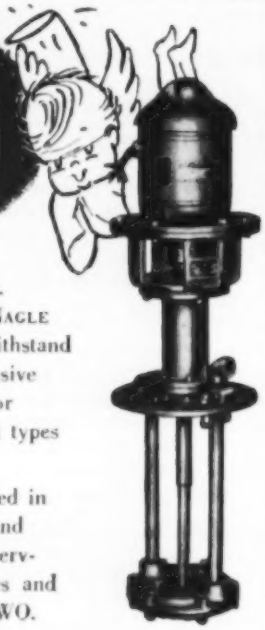
ROCKWELL SINCE 1888 BUILT

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

2504 ELIOT STREET • FAIRFIELD, CONN.

Sales Representatives in Principal Cities

THIS PUMP HAS A Conscience!



It will guard your investment with its life. Outlasting ordinary pumps many times, NAGLE PUMPS are designed and constructed to withstand abusive service, such as pumping highly abrasive mixtures, corrosive liquids, hot solutions or heavy slurries. Horizontal and vertical shaft types in complete range of sizes.

Type "SW-O" shown, is directly submerged in material to be pumped. Free of packing and bearing troubles. Rendering outstanding service in important processing plants, mines and mills. Get the facts—ask for Bulletin SWO.

NAGLE PUMPS

NAGLE PUMPS, INC.

1251 CENTER AVE., CHICAGO HEIGHTS, ILL.

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

New Equipment . . .

the valve may be positioned accurately at pressure differentials as high as 3600 psi with standard superstructures actuated by standard instrument air output.

Tight shutoff is attained by sealing the pressure in the body bowl from the balancing chamber with the exclusive Dahl seal. With the plug on its seat, the line fluid would normally tend to flow through the space between the plug and guide and continue through the drilled passage to the down-stream side. This is prevented by interposing a Dahl seal around the plug near the top of the guide. Made of an inert, low friction plastic, this seal requires little or no maintenance and is highly resistant to corrosion or chemical attack.

These valves are manufactured in sizes from 1- to 8-inch with body ratings from 150 pounds to 1500 pounds ASA Standard at a temperature rating of 450 F.

For more detailed information, just .

Circle E4 on Postcard

Receiver Recorder

Bailey Meter Company is introducing a new receiver recorder for pneumatic and electrical transmission systems and the refining, natural gas and petrochemical industries. This new instrument will record any measured variable which may be converted to pneumatic or electric signals.

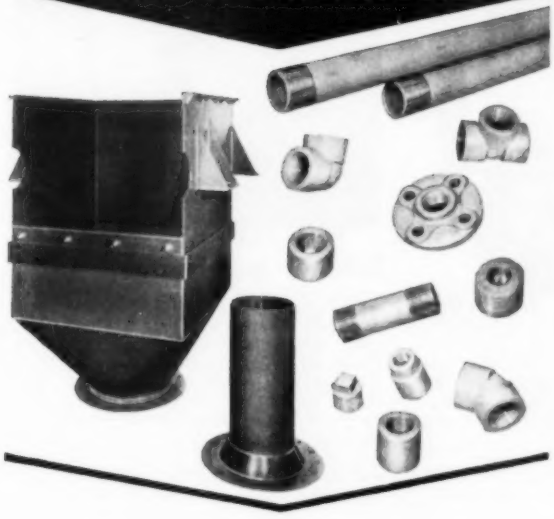
The standard recorder is available which keeps continuous independent records of one to four pneumatic and electric transmissions in any combination. Unique, plug-in, precalibrated receivers make this advancement possible. Also featured in this new instrument are fountain-type recording pens which provide continuous feed for one year without refilling. The new pens are stainless steel capillary, fed from hermetically sealed ink sacs.

Receiver units may be added or interchanged, permitting easy field adaptation to new or revised metering and control applications. Too, plug-in escapment type integraters may be fitted in the same casing with two flow records. Complete details are available on this

STOP Corrosion with...

Van-Cor

PLASTIC PIPE, FITTINGS AND FABRICATIONS



★ *Both Chemically Resistant and Impact Resistant Types*

★ *Half the Weight of Aluminum, with High Tensile Strength*

★ *Readily Formed, Machined, Drawn, Molded or Welded*

AVAILABLE FORMS

SHEETS... 1/32" through 1". PIPE... 1/2" through 8" diameter (10 or 20 ft. lengths). ROUND BARS... 3/8" through 5" diameter (10 ft. lengths). WELDING ROD... 1/8" and 5/32" diameter.

TYPICAL APPLICATIONS

A rigid non-plasticized polyvinyl chloride, Van-Cor is fabricated into such products as: Ducts, Hoods, Chemical Tanks, Tank Liners, Plating Racks, Fume Stacks and Piping.

WRITE FOR ILLUSTRATED BULLETIN, SPECIFICATIONS, AND NAME OF NEAREST DISTRIBUTOR

INDUSTRIAL DIVISION OF
COLONIAL PLASTICS MFG. CO.

SUBSIDIARY OF THE VAN DORN IRON WORKS CO.
2685 EAST 79th STREET • CLEVELAND 4, OHIO

So SIMPLE We Can Adapt It to ANY LIQUID LEVEL CONTROL JOB

A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol.

MAGNETROL

AS DEPENDABLE AS MAGNETIC FORCE ITSELF

● No matter how specialized the liquid level control application, adapting Magnetrol to meet it presents no problem. Whether it's for high pressures, high temperatures, corrosive liquids or any other condition, a few "standard" modifications and the job is done! Operation is so simple no changes in basic design are needed. That's why Magnetrol "fits" practically any application — why "specials" are so often standard with us.

Because of the utter simplicity and dependability of its magnetic principle, Magnetrol has *infinite operating life.* There is nothing to wear out or mal-function.

Magnetrols are available for controlling level changes from .0025-in. to 150-ft., with single or multi-stage switching. Our experienced engineering staff is at your service.

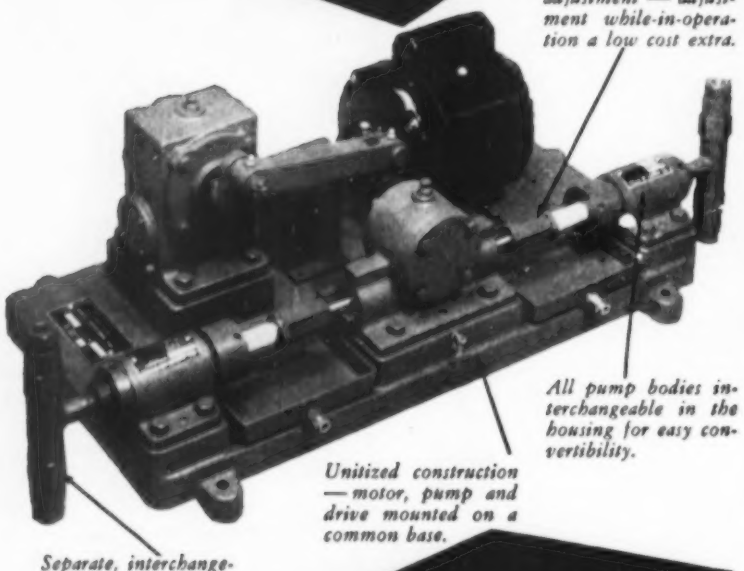
MAGNETROL, Inc.

WHY NOT MAIL THE COUPON — NOW

MAGNETROL, Inc., 2112 S. Marshall Blvd., Chicago 23, Illinois
Please send me catalog data and full information on Magnetrol Liquid Level Controls.
Name_____
Company_____
Address_____
City_____ Zone____ State_____

For more data on advertised products, use Readers' Service Cards, last page.

Can your proportioning pumps match this for convenience and versatility?


Easy, precise stroke adjustment — adjustment while-in-operation a low cost extra.
All pump bodies interchangeable in the housing for easy convertibility.
Unitized construction — motor, pump and drive mounted on a common base.
Separate, interchangeable external check valves for easy dismantling or replacement.

HILLS-McCANNA "U" TYPE PROPORTIONING PUMPS

Hills-McCanna "U" Type Proportioning pumps combine precision operation with high standards of convenience and versatility not ordinarily associated with pumps of this type. The "U" pump is easy to install and can be converted quickly and economically for changing service requirements.

If you must continuously meter or proportion small volume flows with great accuracy, it will pay you to consider a Hills-McCanna "U" Type Pump. Capacities range from 0.10 to 24 gph per feed, 1, 2, 3 and 4 feed units are available.

Write for Catalog UP-54. HILLS-McCANNA CO., 2441 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

metering and proportioning pumps

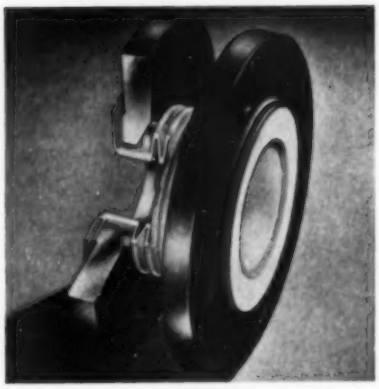
Also Manufacturers of:
SAUNDERS TYPE DIAPHRAGM VALVES
FORCE FEED LUBRICATORS • MAGNESIUM SAND ALLOY CASTINGS

New Equipment . . .

new instrument now.

This item supplements Bailey Meter Company data on pages 162-163 in The Refinery Catalog, 21st Edition.

Circle E5 on Postcard



Bellows and Flanges

Chemically inert, corrosion and heat resistant bellows made from Teflon are now available from Crane Packing Company with companion flanges conforming to American Standard Bolt Hole circles and numbers for pressures up to 125 psi. They can be supplied to fit any pipe size from ½-inch to 12 inches. The bellows feature a new convolution form designed to give greater strength, longer life, and increased flexibility. The operating temperature range is from —94 to 500 F.

Bellow flanges are of French-type gasket construction to provide more efficient sealing at lower flange pressure. Typical applications for these new bellows include vibration dampeners, expansion joints and connectors. They are available in a wide range of designs suitable for metering pumps, pressure accumulators, batching scales, hydraulic systems, and others.

Complete information is available on this new product now.

This item supplements Crane Packing Company data on page 287 of The Refinery Catalog, 21st Edition.

Circle E6 on Postcard

BTU Recorder

The Bristol Company has just announced its new Dynamaster BTU Recorder-Controller System. This system can be used to measure and record the quantity of heat supplied to or drawn from process vessels, refrigerating plants, air conditioners, and a variety of other heat exchanging devices. Control apparatus is available for regulating the temperature or flow rate of the heat transfer medium.

In the basic BTU recording system, one instrument measures the temperature difference with two resistance thermometer bulbs and receives the flow rate from a flow transmitter. From the

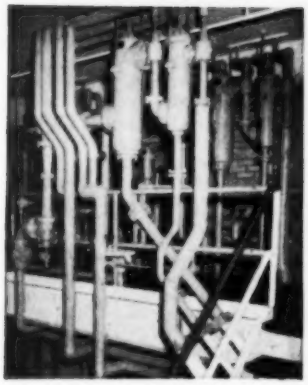


Photo Courtesy of
Hoffmann-LaRoche, Inc., Nutley, N. J.

LET
C-R EVACTOR UNITS
help improve your health

This illustration shows two 4-stage EVACTOR units in the plant of a leading manufacturer of vitamins and other pharmaceuticals. The same plant uses numerous other C-R EVACTOR units of different types—as do the majority of manufacturers in this important field—for many different processes, including deodorizing, distilling, drying, refrigeration, etc. They are as simple as the valves that turn them on, yet maintain absolute pressures down to a small fraction of 1 m.m. absolute where steady, dependable vacuum is extremely important.

This steady, dependable vacuum is contributing to the improved health of our population by helping to supply purer and more potent vitamins, antibiotics and other pharmaceutical products. It is contributing indirectly to the health of many operators and executives in other manufacturing industries, by minimizing worry over vacuum problems. This also applies to Jet Mixers, Jet Heaters, Jet Absorbers, Jet Scrubbers, Jet Pumps, Jet Condensers and Barometric Condensers.

CROLL-REYNOLDS

Croll-Reynolds CO., INC.

Main Office: 751 Central Avenue, Westfield, N. J.
New York Office: 17 John St., New York 38, N. Y.
CHILLVACTOR EVACTOR STEAM JETS CONDENSING EQUIPMENT

LIQUID SCINTILLATION DETECTOR

Tracerlab's unique CE-1 Liquid Scintillation Detector is designed primarily for counting samples of low energy beta emitters such as C-14 and Tritium, which can be prepared in liquid form. Efficiencies of approximately 75% for C-14 and 20 to 25% for Tritium can be obtained with this unit. The total sample volume is 50 cc and sample preparation is extremely simple.

An extremely low background of only 200 to 250 CPM is obtained by refrigeration of the phototubes, use of a dual-channel coincidence amplifier which passes only pulses which occur at the same time, and an overpulse rejection circuit. The two photomultiplier tubes with preamplifiers and a scintillation cell are mounted inside a lead shield in a small refrigerator. Samples may be stored in the dark before counting and a glove port permits transferring samples without exposure to light.

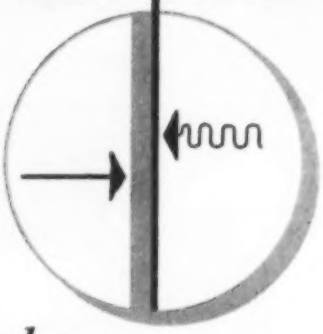
Booklet TL 59 contains complete details and will be sent upon request.

Tracerlab

For more data on advertised products, use Readers' Service Cards, last page.

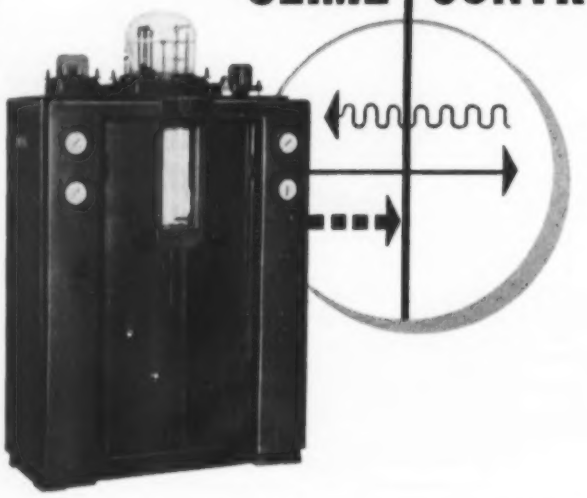
Where you need

HEAT | EXCHANGE



Be sure you have

SLIME | CONTROL



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

WALLACE & TIERNAN

25 MAIN ST., BELLEVILLE 9, N. J.

CHLORINATORS • CHEMICAL FEEDERS • SCREENING EQUIPMENT • MAGNETIC SEPARATORS • PRECISION PRESSURE INSTRUMENTS • CATHODIC PROTECTION • FINE CHEMICALS

CD-30

New Equipment . . .

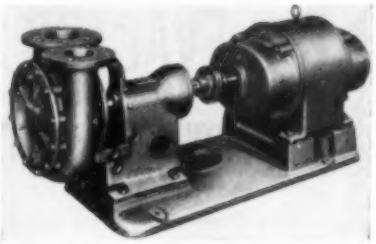
two variables, it then continuously computes and records the BTU product.

Other systems are offered that provide for recording temperature differences along with BTU's on a single round or strip chart by a single 2-10 Dynamaster. In most instances, totalizers can also be furnished with the BTU recorder to integrate the energy or heat-transfer. Matched resistance bulbs are not required. An optional bulb trimming adjustment can be supplied enabling the user to install a replacement bulb and match it to the system by trimming the bulb and lead wires with the bulb trimming adjustment.

Other systems, to meet specific needs, can be provided.

For complete technical details on this new development, simply . . .

Circle E7 on Postcard



Centrifugal Pumps

A new line of centrifugal pumps designed especially for handling corrosive liquids and slurries is being announced by Goulds Pumps, Inc.

The new pumps, designated as the fig. 3715 series, embody a number of significant improvements over earlier Goulds pumps. They are available with the entire fluid end in 316, Gould-A-Loy 20, or 304 stainless steels, all iron, all bronze, bronze-fitted, all iron with stainless trim, or all bronze with stainless trim.

These pumps are of support-head construction with the support cast integrally with the bearing housing. The maximum liquid temperature limitation for operation of the pumps is 350 F. and the pumps are provided for water cooling of the support-head and quenching of the gland.

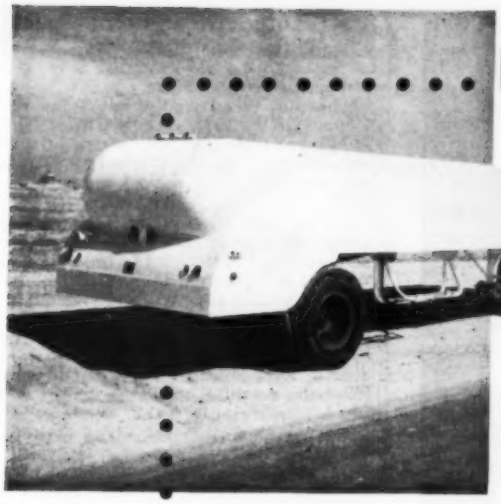
Single or double mechanical seals can be provided if desired, and they can also be quenched.

For complete operating details on this new line of pumps, just . . .

Circle E8 on Postcard

Bottle Washer

Namco Machinery, Inc., is announcing the availability of a new product which should find wide acceptance in the refining, natural gasoline and petrochemical industries. This new product is a bottle washer whose low price and compact size should make it extremely attractive to a great many refineries who cannot justify the expense of larger



DESIGNED FOR YOU!

FOR YOUR *Product*

FOR YOUR *Budget*

What's your product . . . gasoline, butane, anhydrous ammonia? No matter what it is, Lubbock Machine and Supply Company can manufacture a transport tank that's engineered for your product and priced for your budget. Your transport tank from Lubbock Machine and Supply will carry the maximum pay load for your state, fit your individual trucks, and conform to state highway and ICC regulations. Write today for information regarding prices, pay loads, our easy budget plan, etc.

LMC
LOW MILEAGE COST

LUBBOCK MACHINE & SUPPLY CO.

P. O. DRAWER 1589 PHONE 2-5261 LUBBOCK, TEXAS

Retubing 10,000 tube Turbo Condenser with special rigging and tools.

Stainless Steel Bundles for corrosive Gas Exchanger in process of construction.

Replacement Vapor Condenser Bundle for refinery ready for shipment.

RETUBING SERVICE

24 hours a day—7 days a week

"CONSECO" is well equipped and thoroughly qualified to repair, retube and rebuild any type of tubular equipment. We are prepared to do this work in the field or in our own plant.

For emergency assignments we maintain complete repair facilities that literally "never sleep". For assured satisfaction, for low cost and down time, call "CONSECO".

Write, Wire or Phone: Field Department

CONSECO PRODUCTS

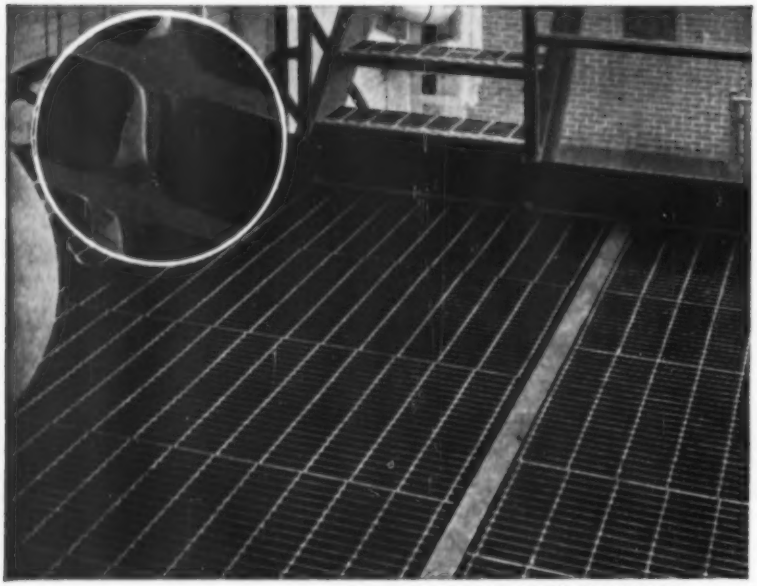
- Retubing
- Condensers
- Evaporators
- Air Ejectors
- Heat Exchangers
- Flowrites
- Tube Plugs
- Conco Plugs and Guns
- Bevel Gears
- Instrument Repair Service
- Blackburn-Smith
- Filters and Grease Extractors
- Metal Spray

Bulletins Available for Above Items

CONSECO **Condenser Service & Engineering Co., Inc.**

56 BLOOMFIELD STREET, HOBOKEN, N. J. HOBOKEN 3-4425—N. Y. TEL: BARCLAY 7-0600

For more data on advertised products, use Readers' Service Cards, last page.



Grating by BLAW-KNOX

where can **you** use **steel grating?**

You undoubtedly use a lot of steel grating in your plant—floors, platforms, walkways, catwalks and stair treads, for example.

But how about grating for fan guards and shelving—for covering open pits and light wells? And how about other uses throughout your plant that no one has thought of—as steel grating is adaptable to many uses.

If you have any problem about a common application or an unusual application or a possible application, we'll be glad to hear from you. And to give you a prompt answer.

Only Blaw-Knox Electroforged® Steel Grating and Stair Treads —have these five exclusive features:

1. **rigid one-piece construction—easy to install**
2. **all surfaces accessible—easy to paint**
3. **no sharp corners to clog—self-cleaning**
4. **maximum open area—for light and ventilation**
5. **non-slip twisted crossbar—safe footing**

A short note will bring you a copy of new Bulletin No. 2365-R—a dimensional sketch will bring you a quotation.

BLAW-KNOX

BLAW-KNOX COMPANY
2005 Farmers Bank Building • Pittsburgh 22, Pennsylvania

BLAW-KNOX EQUIPMENT DIVISION
GRATING DEPARTMENT

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.

New Equipment . . .

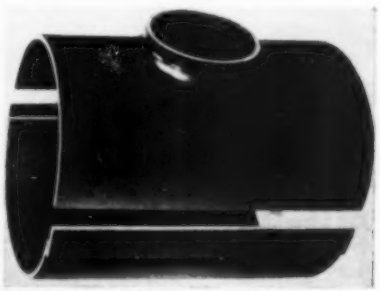
equipment of this nature.

The unit is especially suited for the 4-ounce to 1-quart sample bottles, and is designed to remove such difficult materials as "bunker C" fuel oil. There are also provisions for drying with the unit.

Called the Unormatic, the unit is completely automatic in its operation. The operator merely loads the tray and slides it in to the machine. The machine then automatically washes the glassware, rinses it and shuts off; or automatically dries and then shuts off. The operator does not touch the glassware during any treatment. He is free to leave the machine once it is loaded and the door is closed.

For complete details on this new development, just . . .

Circle E9 on Postcard



Full Encirclement Saddle

A recently developed Tube-Turn full encirclement saddle represents a marked improvement over the conventional techniques employed in "hot tapping" of piping, when branch connections are to be installed. It is manufactured by Tube Turns, a division of National Cylinder Gas Company.

The design of the new full encirclement saddle is the first to be offered of several being evolved from Tube Turn's quarter of a century experience in the solution of petroleum piping problems.

Complete engineering details on this new item as well as suggested installation technique are available now.

This item supplements Tube Turns, Inc. data on pages 842-843 in The Refinery Catalog, 21st Edition.

Circle E10 on Postcard

Teflon Seal Cage

A new one-piece flexible seal cage has been developed by Chemical & Power Products, Inc., for use with stuffing boxes on pumps, mixers, reactors and other types of processing equipment.

These seal cages were developed to overcome the handicaps experienced with two-piece metal lantern rings. Chempro seal cages, machined in one piece, can be easily snapped over the shaft without dismantling pump or pulling the shaft. They will not score the shaft during operation, even at high speeds. They are designed and constructed to provide a seal cage that will

FREE CATALOG!

available to you who are interested in the facts on open steel flooring.

Up to the minute information on the hows and whys of construction and installation of Tri-Lok Open Steel Flooring may now be at your finger-tips. Here is a four-page catalog designed to aid you in selecting the best types and styles of open-steel flooring for your particular construction project.

IN THIS CATALOG YOU'LL FIND

- Tables of Safe Loads
- Specifications required for open steel flooring installation
- Types of Tri-Lok Open Steel Flooring available
- Information concerning construction, sizes, strength and adaptability of Tri-Lok Open Steel Flooring

FOR YOUR COPY, WRITE FOR BULLETIN PW 1102-243

DRAVO
CORPORATION
National Distributor for THE TRI-LOK COMPANY
Fifth and Liberty Avenues, Pittsburgh 22, Pa.

HIGH QUALITY
ANHYDROUS
Aluminum Chloride
PRODUCED IN TWO GRADES
RESUBLIMED & SUBLIMED

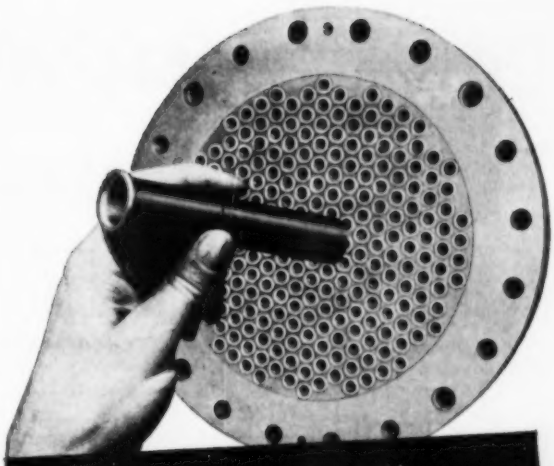
THE PUREST COMMERCIAL MATERIAL AVAILABLE

ANY PARTICLE SIZE OBTAINABLE
OUR STANDARD SIZES
POWDER (-20 MESH) GRANULAR (-4 + 20 MESH) LUMP (-1 + 4 MESH)

INFORMATION CONCERNING THE PREPARATION of AQUEOUS OR ALCOHOLIC SOLUTIONS OF $AlCl_3$ OBTAINABLE BY WRITING

OHIO-APEX DIVISION
FOOD MACHINERY & CHEMICAL CORPORATION — NITRO, W. VA.

OHIO APEX fmc — PLASTICIZERS & CHEMICALS



Profit Two Ways With...
WILSON Condenser Tube Inserts

1 Put Equipment Back on Line Faster

You save man-hours and money with new Wilson Condenser Tube Inserts because they eliminate the need to plug off leaking condenser or heat exchanger tubes. Wilson Inserts go in fast...need no cementing...take less time than it does to plug a "bad tube". What's more, these highly efficient inserts put the tube back into operation as in the original design.

2 Multiply Service Life of the Tube

In many cases, condenser tubes usually fail within the first few inches of the inlet. Wilson Condenser Tube Inserts actually restore these leaking tubes to service by sealing the deteriorated portion of the tube. Wilson Inserts also retard or eliminate the effect of inlet end erosion.

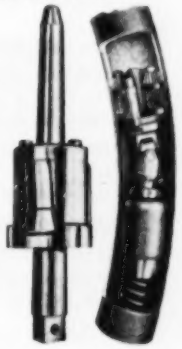
Send for Bulletin 500 which gives the full story on time-saving, money-saving Wilson Condenser Tube Inserts.

Wilson Tube Cleaners

Depend on these powerful, fast-acting cleaners to do a thorough job every time. There's a Wilson cleaner for all types of tube or pipe. All sizes in stock for immediate delivery.

Wilson Tube Expanders

For re-rolling old tubes or installing new ones. Precision-made to insure firm seating. Self-feeding and parallel expansion for a particular trade.



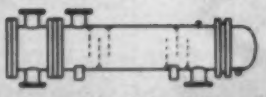
Representatives in principal cities

THOMAS C. WILSON, INC., 21-11 44th Ave., Long Island City 1, N. Y.
Cable address: "Tubeclean", New York

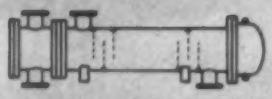
TW641

WILSON
TUBE CLEANERS • TUBE EXPANDERS

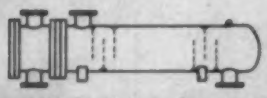
WHITLOCK STANDARD EXCHANGERS



Type SG straight tube, outside packed lantern gland design — eliminates undetected fluid inter-leakage.

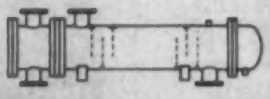


Type ST conventional straight tube, split ring, floating assembly construction.

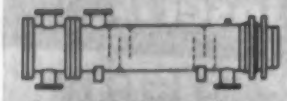


Type R U-tube design — low cost construction, for non-fouling service.

Straight tube, fixed tube sheet design—Types V and V-1 — for easy mechanical cleaning.



Type S pull-through floating head design — for condensing, heating services — for easy maintenance.



Floating head heat exchangers Type SO with outside packed head — no concealed, bolted and gasketed joints.

Double pipe heat exchangers —for counter-temperature flow conditions and low flow rates.

Type C coil type heat exchangers — for high tube side pressures.

SAVE WITH "STANDARDS"

It pays to consider Whitlock Standard Exchangers FIRST. You can make important savings with standard designs:

1. **You save time — "prints for approval" are immediately available for your Engineering Department to use in planning piping and other layouts.**
2. **You save engineering costs — yet you obtain individual engineering attention to assure that the standard design selected is best fitted to your particular needs.**
3. **You save delivery time — units are manufactured from stocked materials and subassemblies. Many completed units are also maintained in stock.**
4. **You save on downtime — duplicate parts are readily available to answer emergency requirements and to reduce downtime.**
5. **You save on first cost — quantity-produced subassemblies and quantity-purchased materials reflect sizeable cost savings: our published price list is tempered by actual production experience. Consult this list and see how Whitlock Standard Exchangers can save you money.**

Whitlock is ready to help you — send for new bulletin describing the complete line of Whitlock Standard Exchangers and outlining dimensions, capacities, and types of services. The Whitlock Manufacturing Co., 75 South St., West Hartford 10, Connecticut.

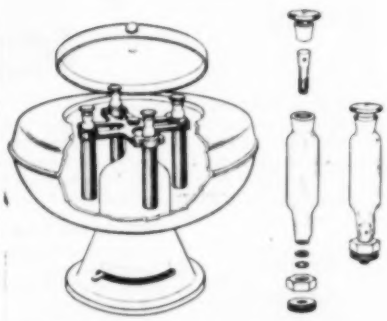
WHITLOCK

New Equipment . . .

not bend or collapse under extreme gland pressure.

Chempro seal cages are available in standard or special sizes to fit any pump, mixer or agitator. For additional information on this product . . .

Circle E11 on Postcard



Separatory Funnel

A new glass separatory funnel developed by Fischer & Porter Company eliminates stop cork lubrication and freezing problems. Named Ultramax, the valve of the separatory funnel consists of a Teflon plug which turns on the natural glazed surface of an unground, precisely formed section of pyrex tubing. Product contamination is avoided because valve lubricants are unnecessary, and the inert Teflon valve cannot freeze regardless of the fluid being handled.

Further details of this new separatory funnel are available now. Simply . . .

Circle E12 on Postcard

Fire Fighting Hose

A new fire fighting hose for the refining, natural gasoline and petrochemical industries has been developed by Quaker Rubber Corporation, a division of H. K. Porter Company.

The new hose, named Petrokem, is built to resist severe oil, chemical, and abrasive conditions which tend to deteriorate ordinary fire hose. A partial list of materials having little or no effect on Petrokem include:

- Alcohols
- Bleaching agents
- Hydrocarbons
- Ketones
- Synthetic detergents.

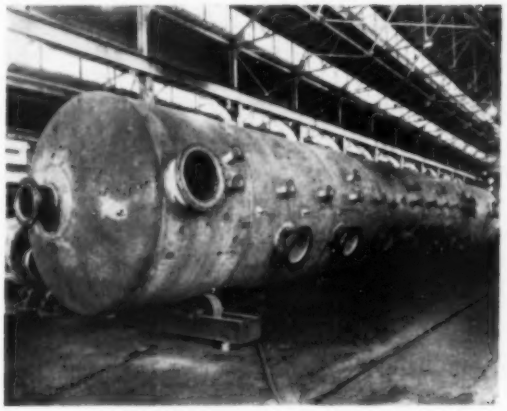
It has excellent resistance to weak acids even at boiling temperatures and to strong acids at room temperature.

Constructed of an oil resistant Neoprene tube and covered with a strong Dacron yarn, Petrokem is impregnated with a skin coat of Neoprene, making it oil resistant both on inside and outside. It is designed as a tough, flexible, easily handled hose, capable of withstanding temperatures as high as 375 F. and pressures of 500 psi.

For complete information on this new development, just . . .

Circle E13 on Postcard

Streamline Welded



STEEL FRACTIONATING TOWER

113" I.D. x 65'0" Long

PROCESS EQUIPMENT

AND

PRESSURE VESSELS

F & T Products

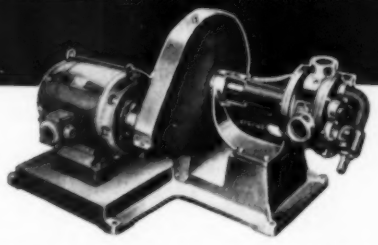
Absorption Towers
Alloy Steel Equipment
Butane Storage Tanks
Fractionating Columns
Heating Boilers
Oil Country Boilers
Recirculating Furnaces
Autoclaves
Bubble Towers
Catalyst Towers
Heat Exchangers
Jacketed Vessels
Power Boilers
Tanks
Waste Heat Boilers

FARRAR & TREFTS INC.

Established 1863

Buffalo 12, New York

There's a Viking Pump for every requirement



Viking Pumps are old reliable friends in the Oil Industry . . . and Southern Engine & Pump Company engineers are regularly utilizing their versatility and dependability in units for every service. Whatever your special requirement—they'll be glad to help you.

Pictured above: Gear drive unit includes gearing totally enclosed in sheet metal guard. Size and type of gearing as well as outboard bearing support depends on the size and speed of power unit needed.

Distributors

SOUTHERN ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS

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Corpus Christi, Texas

How you can get longer pump-valve life

SIMS PUMP VALVES HAVE FOUR FEATURES THAT GUARANTEE LONGER LIFE

1 Double shock absorber stem heads—eliminate stem breakage.

2 Long guide—low wear—even lift, no binding. Spring can't jam.

3 Rotating valve disc—wears slowly, evenly; can't pound up and down on same spot.

4 Inclined seat ribs—less flow-resistance, reduce volatilization, allow higher pump speeds with a full cylinder—more output.

Complete stocks on hand. • Used by blue chip companies throughout the U.S. • Ask for Bulletin PR-3 or a report on what these valves can do for you—no obligation.

Sims PUMP VALVE CO., INC.

1314 PARK AVENUE, HOBOKEN, N. J.
M&M BLDG., HOUSTON, TEXAS

BP-105

What's New in Manufacturers' Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

Constructor's Book

"Dravo—Engineering Constructors," is the title of a new 45-page book released by Dravo Corporation which describes the services and activities offered by its Machinery division, Construction department. Prepared as a photographic story, the book shows typical pipe line pumping and compressing stations completed by Dravo. An introduction explains how the department staff of engineering construction specialists are equipped to consummate any type of working contract.

Circle E14 on Postcard

Instrumentation Bulletin

A new system of instrumentation developed by General Filter Company for the measurement and/or control of liquids is described in a new eight page bulletin, "Pneumatic Operated Control." The bulletin illustrates the five basic principles used in this system as well as its uses and applications in water and waste treatment plants. It also shows the ease with which the system can accomplish all the various types of process measurement and control. The booklet includes complete specifications and is available now.

Circle E15 on Postcard

Refractories Bulletin

Two Harbison-Walker refractories, Coleman XX for high-duty service and Coleman for intermediate service, are described in a new 8-page bulletin now available. In addition to descriptive details, the bulletin includes charts showing spalling resistance, the results of load tests, and the results of thermal expansion tests. A section is also devoted to several other products at Harbison-Walker's plant.

To receive your copy of this informative bulletin, simply . . .

Circle E16 on Postcard

Control Valve Booklet

Three fundamental types of air control valves are described and illustrated in a new four-color 12-page booklet published by Ross Operating Valve Company. The booklet explains the primary advantages of air power including speeds, cleanliness, economy, resiliency, and lightness.

The three basic models illustrated are the integral pilot operated, the remote controlled, and the direct operated valves. With minor variations, these units can be adapted to a wide range of applications.

Colored diagrammatic drawings show clearly how the air flows through the valves and to the operated cylinders. The advantage of each type, an explanation of how they work, and a list of available standard models are included. To receive your copy of this new booklet, simply . . .

Circle E17 on Postcard

Boiler Bulletin

Henry Vogt Machine Company has recently released its bulletin, MSG-1, covering Vogt multisteam generators. This bulletin completely describes these generators which are designed to concentrate refinery waste heat sources and to produce low cost steam. To receive your copy of this informative bulletin, simply . . .

Circle E18 on Postcard

Electrode Catalog

A new catalog describing pH electrodes and electrodes for measuring redox potentials, as well as electrode assemblies, parts and accessories, has been published by Leeds and Northrup Company. This book covers a complete L & N electrode line, chemicals for electrode servicing, and auxiliary electrode equipment such as clamps, holders and thermometers.

It is primarily designed to present electrode assemblies for measurement, recording and/or control of solution pH and redox potentials.

Your copy of this book is available now. Just . . .

Circle E19 on Postcard

Swivel Bulletin

A new colored descriptive bulletin covering the Emsco HP&HT small size high-pressure and high-temperature ball bearing swivel fittings is now being made available from Emsco Manufacturing Company.

Emsco's line of small size ball bearing swivel fittings range in size from 3/8 inches to 1 inch and from working pressures of 6000 psi at 225 F. to 1250 psi at 750 F. These fittings are very versatile in their application and should find many uses throughout the refining natural gasoline and petrochemical industries.

The new bulletin describes the method of construction and application of these fittings as well as giving complete dimensions, specifications, weights and engineering data. It is illustrated with many sectional drawings and clearly shows the various types of packing for steam, hot water, oil, LPG, etc.

To receive your copy of this informative bulletin, simply . . .

Circle E20 on Postcard

Industrial Catalogue

A new catalogue describing characteristic activities of the Schneider group of France during 1953 has just been issued and is available now. This 24-page catalogue (in English, French and Spanish) shows some of the many types of equipment which the group fabricates. These include steam turbines, traveling cranes, refining and chemical plant equipment, diesel engines and heavy steel castings. Your copy of this catalog is available now. Just . . .

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Instrumentation Bulletin

Instrumentation for the modern plant is presented in the new 16-page 1954 edition of Bailey Meter Company's annual Bulletin 17. Detailed equipment descriptions and illustrations include basic specifications for measuring, transmitting, receiving, interpreting, and controlling 18 variables normally encountered in the refining, natural gasoline and petrochemical industries. This new thoroughly illustrated bulletin is available now. Just . . .

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Storage Tank Bulletin

Graver Tank and Manufacturing Company has recently prepared a bulletin describing its line of bulk storage tanks. Included in this new bulletin are specifications on capacity, size, plate thickness and weight for Graver standard horizontal bulk storage tanks. Horizontal tanks for both underground and above ground use are described as well as vertical storage tanks.

Also given in this new bulletin are gage tables for 8-foot and 10-foot, 6-inch diameter horizontal tanks as well as a gage table for 10-foot, 6-inch diameter vertical tanks. To receive your copy, simply . . .

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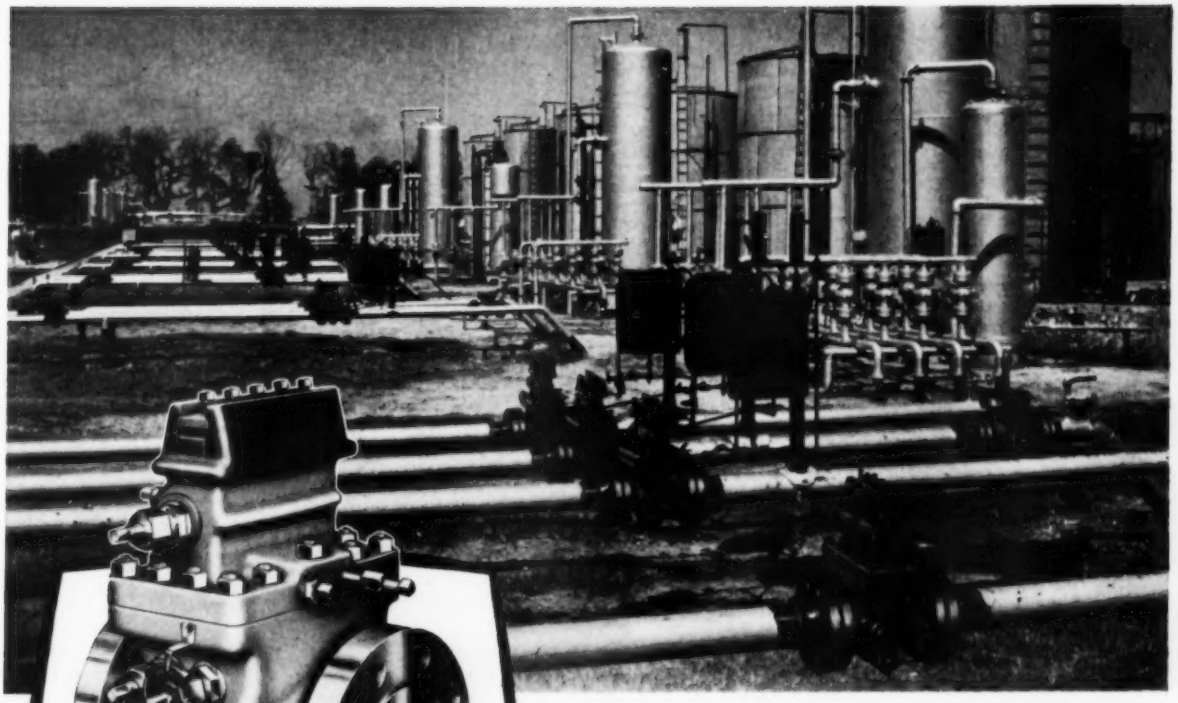

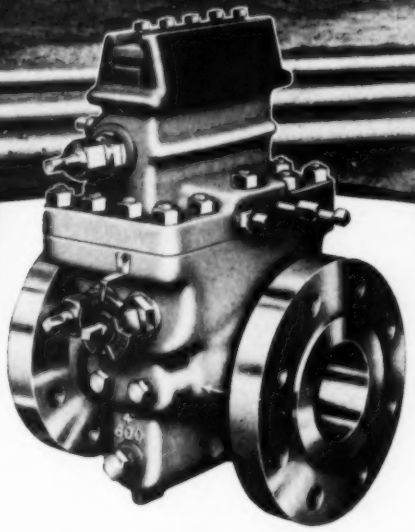

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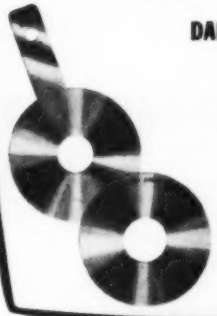

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DANIEL ORIFICE FITTINGS, METER RUNS, CHECK VALVES AND OTHER DANIEL PRODUCTS — have been designed for the future as well as the present. Whether small flow or large . . . liquid or gases . . . Daniel Orifice Measurement equipment is constantly being specified for installations in every major oil and gas producing area throughout the world because of proven dependability, quality and satisfactory performance.

Consult the Refinery Catalog for a listing of all Daniel products, or write for detailed information.

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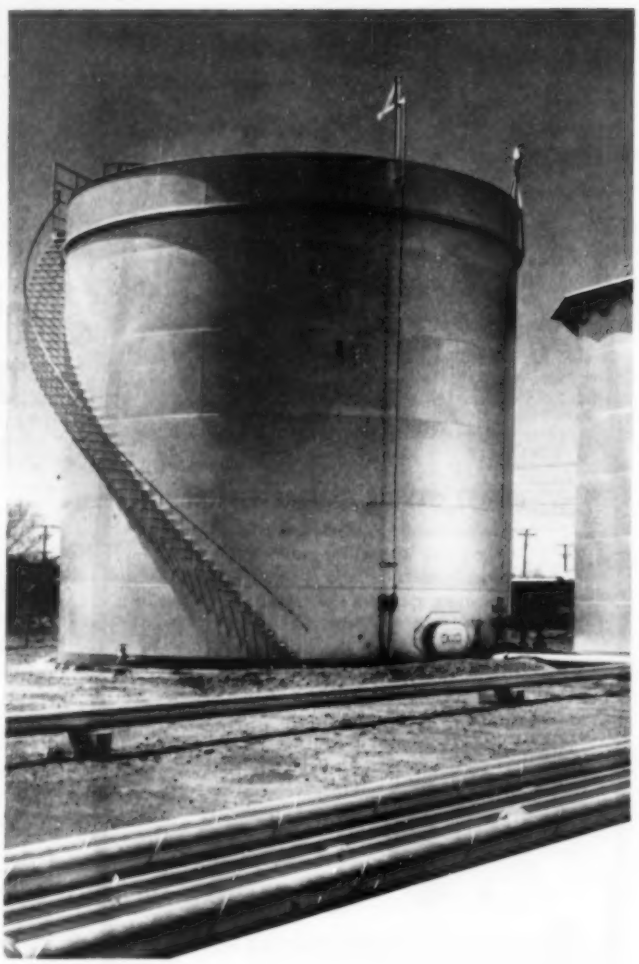
For more data on advertised products, use Readers' Service Cards, last page.

Storing "Black Gold" near Sutter's Fort

The gold seekers of 1849 and 1850 who reached the sight of Sutter's Fort, now the City of Sacramento, California, never dreamed that "black gold" would be more important to the area than the type that glitters. Such is the case though, for without petroleum products the wheels of civilization would soon stop turning.

The structure shown at the right is a 6,500-bbl. tank 36-ft. in diam. by 36-ft. high equipped with a Horton® Double-Deck Floating Roof. It is located at the General Petroleum Company's terminal in Sacramento California, where gasoline, diesel fuel, fuel oil, automotive oils and lubricants are stored for delivery throughout the area.

Horton Floating Roofs reduce evaporation loss, decrease corrosion and eliminate fire hazard from stored volatile liquids. Built in three types—Double-Deck, Pontoon and Pan—all three are equipped with the Horton Seal to close the space between the tank shell and the edge of the roof. Further information and assistance in selecting the proper Horton Floating Roof can be obtained by writing our nearest office. There is no obligation on your part.



6,500-barrel tank equipped with Horton Double-Deck Floating Roof. The tank is 36-ft. in diam. by 35-ft. high.

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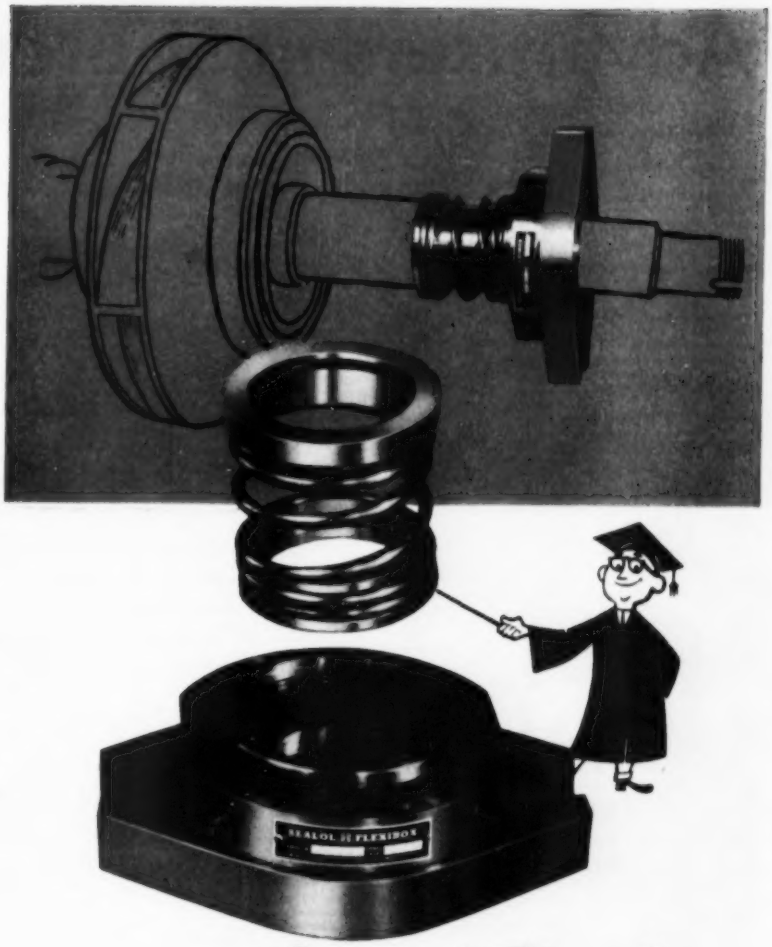

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THE BALANCED PRESSURE SEAL

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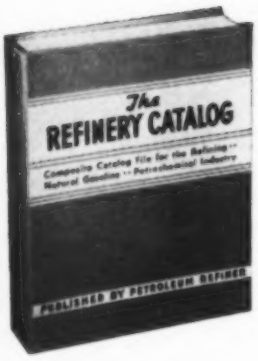
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Composite Catalog File for the Refining — Natural Gasoline — Petrochemical Industry
PUBLISHED BY PETROLEUM REFINER

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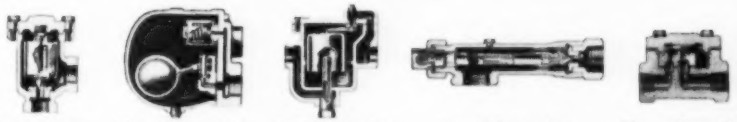

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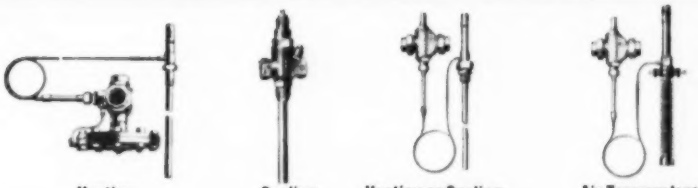

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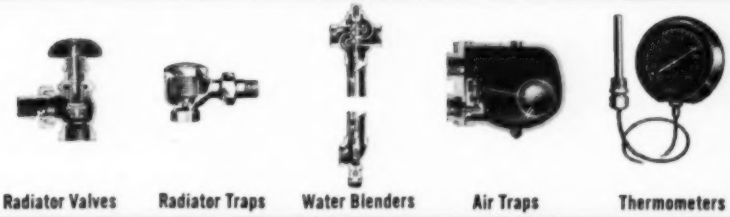

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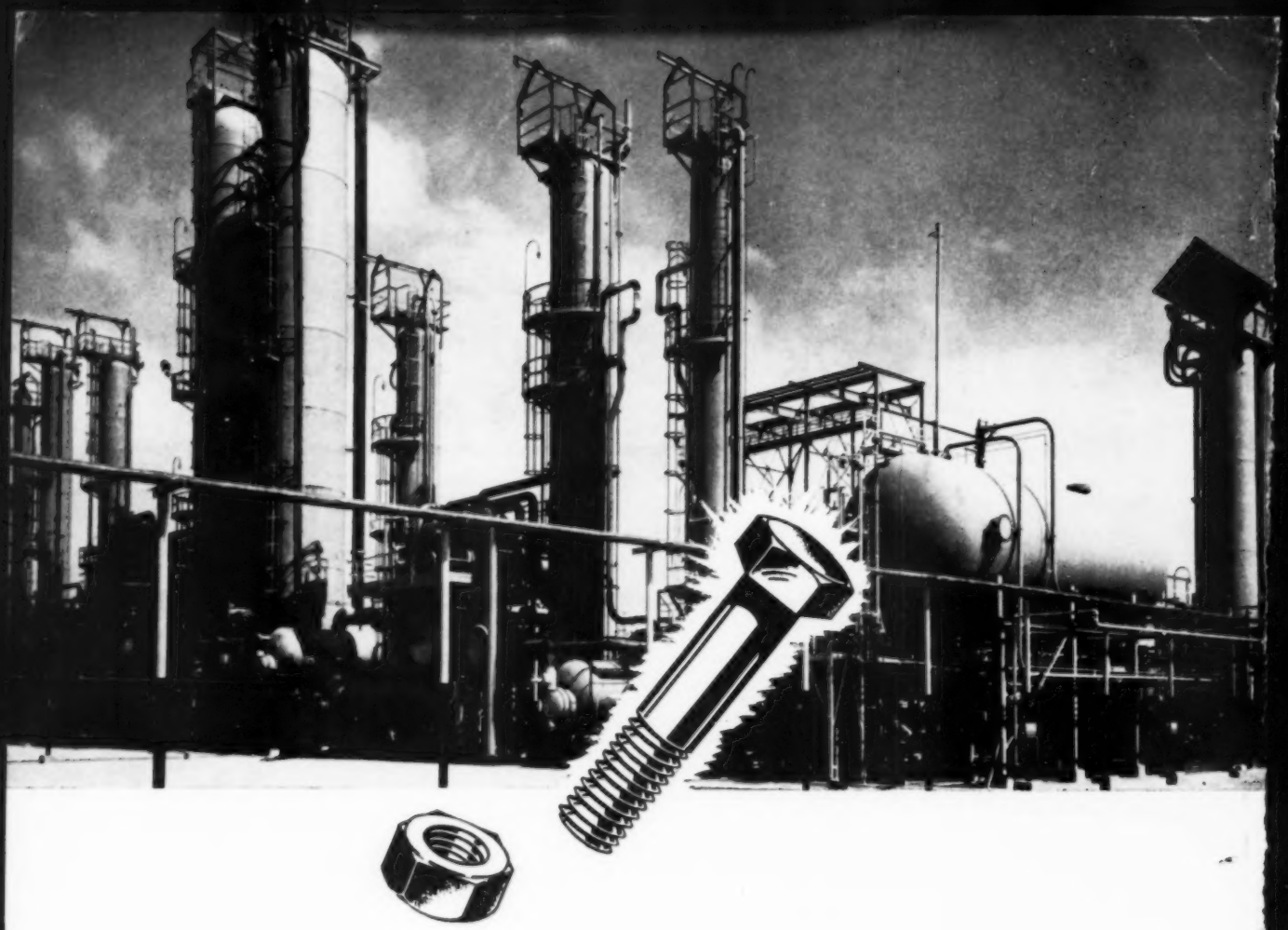

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